

UNIVERZA V LJUBLJANI
FAKULTETA ZA RAČUNALNIŠTVO IN INFORMATIKO

Rok Krulec

Prepričljive tehnologije v mobilnem učenju

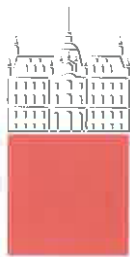
MAGISTRSKO DELO
MAGISTRSKI PROGRAM
RAČUNALNIŠTVO IN INFORMATIKA

MENTOR: prof. dr. Franc Solina
SOMENTOR: doc. dr. Matjaž Kljun

Ljubljana, avgust 2016

Rezultati magistrskega dela so intelektualna lastnina avtorja in Fakultete za računalništvo in informatiko Univerze v Ljubljani. Za objavljane ali izkoriščanje rezultatov magistrskega dela je potrebno pisno soglasje avtorja, Fakultete za računalništvo in informatiko ter mentorja in somentorja.

Besedilo je oblikovano z urejevalnikom besedil \LaTeX .



Številka: 169-MAG-ISO/2016

Datum: 06. 04. 2016

Rok KRULEC, univ. dipl. inž. teh. prom.

L j u b l j a n a

Fakulteta za računalništvo in informatiko Univerze v Ljubljani izdaja naslednjo magistrsko nalogo

Naslov naloge: **Prepričljive tehnologije v mobilnem učenju**

Persuasive technologies in mobile learning

Tematika naloge:


Za globalne korporacije je značilno veliko število zaposlenih in geografska razpršenost enot. Poleg tega, konkurenčnost na svetovnem trgu od njih zahteva vlaganje v človeške vire, da bi lahko ostale korak pred konkurenco. Izvajanje klasičnega izobraževanja je v takih okoljih velik organizacijski izziv in strošek. V nasprotju s klasičnim, mobilno izobraževanje omogoča znanježeljnim, da prilagodijo učenje svojim potrebam in časovnim omejitvam. Vendar je pri samostojnem učenju zelo težko vzpostaviti kontinuiteto pri angažiranju uporabnikov. Za dosego slednjega bo avtor zasnoval in razvil mobilno aplikacijo za e-učenje namenjeno poslovnemu, ki temelji na oblikovalskih smernicah prepričljivih tehnologij. Namen aplikacije je spodbujanje uporabnikov k rednem učenju. Poleg navedenega bo avtor aplikacijo preiskoval v realnem okolju različno velikih globalnih družb in predstavil rezultate.

Mentor:

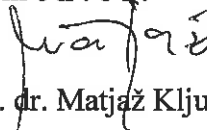

prof. dr. Franc Solina



Dekan:


prof. dr. Nikolaj Zimic

Somentor:


doc. dr. Matjaž Kljun

Contents

Povzetek

Abstract

1	Introduction	1
2	Literature review	7
2.1	Mobile learning	8
2.2	Persuasive technologies and learning	14
3	Method	19
3.1	Experiment design	20
3.2	Triggering implementations	22
4	Application Design	27
4.1	User frontend	27
4.2	Editorial backend	37
5	Results	43
5.1	Phase 1	45
5.2	Phase 2	47
5.3	Phase 3	49
5.4	Comparison of completion and engagement	51
5.5	Time of day usage	54

6	Discussion	57
6.1	Implications for design	58
6.2	Implications for research	65
7	Conclusion	69
	Bibliography	71

Povzetek

Naslov: Prepričljive tehnologije v mobilnem učenju

Avtor: Rok Krulec

Za globalne korporacije je značilno veliko število zaposlenih in geografska razpršenost enot. Poleg tega konkurenčnost na svetovnem trgu od njih zahteva vlaganje v človeške vire, da bi lahko ostale korak pred konkurenco. Izvajanje klasičnega izobraževanja je v takih okoljih velik organizacijski izziv in strošek. V nasprotju s klasičnim, mobilno izobraževanje omogoča znanježeljnim, da prilagodijo učenje svojim potrebam in časovnim omejitvam. Vendar je pri samostojnem učenju zelo težko vzpostaviti kontinuiteto pri angažiranju uporabnikov. Za doseg slednjega smo zasnovali in razvili mobilno aplikacijo za e-učenje namenjeno poslovnežem, ki temelji na oblikovalskih smernicah prepričljivih tehnologij. Namen aplikacije je spodbujanje uporabnikov k rednem učenju. Aplikacijo smo preiskovali v realnem okolju različno velikih globalnih družb. Rezultati kažejo, da uporaba prijemov prepričljivih tehnologij pri mobilnem učenju poveča tako angažiranost uporabnikov kot število uspešno zaključenih tečajev.

Ključne besede: prepričljive tehnologije, mobilno učenje, mobilno e-učenje, m-izobraževanje, proženje.

Abstract

Title: Persuasive technologies in mobile learning

Author: Rok Krulec

Global corporations are characterised by a large number of employees and geographically dispersed offices. Moreover, the competitiveness in the global market requires them to invest in their human resources to be able to remain a step ahead of competition. Implementing large scale classical education in such environments is challenging and costly. Mobile e-learning allows users to tailor their professional education to their needs and time constraints. However, in self-paced education it is very hard to keep user retention and engagement. To achieve the latter we have designed and developed a mobile e-learning platform for corporate environments based on the persuasion and/or gamification design guidelines that try to incite users in regularly using the platform. We have evaluated the application in-the-wild in corporate environments of differently sized companies. The results show that the use of persuasive technologies in mobile learning increases user engagement as well as course completion rates.

Keywords: persuasive technologies, mobile learning, mobile e-learning, m-learning, triggering.

Chapter 1

Introduction

The core challenge of any learning process are engagement, retention and completion. Traditional formal education solves retention by offering daily learning activities, which are more or less engaging and prescribe a clear path to the completion. This is well suited for full-time students, but not so much to lifelong learning and training professionals. Getting into a habit of learning is a possible solution for learners who are not fully-immersed into the study process.

The importance of training for individuals, groups, corporations, and inter corporations has been stressed out and promoted since 1970s [61]. Despite a promising start, corporate learning did not deliver the desired results. Various reasons have been proposed for this: (i) the lack of easily implementable mechanisms to bring corporate learning to life, (ii) focus on the learning rather than outcomes, which are in sync with organisational strategies and objectives, and (iii) changes in the corporate environment (globalisation, corporate universities) [9].

In the globalised world corporations are often geographically dispersed and have a large number of employees of which many are knowledge workers of different kinds [41]. These workers' main capital is knowledge and their jobs include the use and process of information in order to achieve desired goals for a company. As such they are a valuable asset of every company.

“The corporate learning factbook” from 2014 states that the corporations are facing the lack of skills rather than the lack of workforce. It is thus almost a necessity for corporations involved in the competitive global market investing in knowledge of their employees, which is reflected also by the fact that 2013 saw an increase in corporate training budget by 15% [55].

Implementing classical professional seminars for all employees in a globalised world is challenging and costly. For one, traditional classes are limited to one location and to a certain number of hand-picked employees by the management levels [21]. Similar to other areas of life the information communication technologies (ICT) proved to be disruptive in the field of education, training, learning and human resources development (L & D or training and development). Internet and World Wide Web (WWW or web), as its most popular service, made knowledge easily accessible for all users.

Web is by design an open platform and was the main driver of web based e-learning resulting in a plethora of platforms from the commercial Blackboard¹ to the open source Moodle². These systems are commonly known by the name Learning Management Systems (LMS). They have achieved a high acceptance in academia and their (dis)advantages have been studied throughout (e.g. Google Scholar returns over 4 million hits for the term “learning management systems”). The advances and acceptance of these systems have led to several interoperability, progress tracking and learning objects packaging standards such as AICC, SCORM, xAPI, CC/LTI and CMI-5 [7].

The latest e-learning trend on the web are Massive Open Online Courses (MOOC). Besides offering learning content repositories such as Khan academy³ and Videlectures.net⁴, MOOCs resemble traditional classes with interactive user forums to support community interactions among students,

¹<http://uki.blackboard.com/>

²<https://moodle.org/>

³<https://www.khanacademy.org/>

⁴<http://videlectures.net/>

professors, and teaching assistants. Coursera⁵ for example innovated with peer-to-peer knowledge assessments and collaboration environments, mostly partnering with established educational institutions. While Udacity⁶ is seeking ways of effectively transferring modern-engineering knowledge and how to establish a value of learned skills via industry partnerships [15].

It has been noted that the compliance based model or mandatory training where all involved need to finish a selected number of topics is not viable [21, 58]. MOOCs experience massive drop-outs [45, 51] even in the corporate sector [21, 9] while only “people who can immediately benefit from the course, who can make the time and are capable of directing their own learning process ... thrive” [21].

Opening up training that is potentially beneficial to a large number of employees, where each can self-pick desired topics and everyone benefits from the course to a desired level can prove successful [21]. Even so, LMS and MOOCs are most commonly delivered via web and are adjusted to desktop computers or laptops where deliverables demand a lot of writing such as reports or programming, or they demand special software for task completion. It is for this that learners are obliged to reserve large timeframes when and where they have access to these devices as these do not offer a desirable level of mobility to be used in non-places or during dead-time [5].

With ever increasing mobile connectivity a new type of e-learning has emerged called also mobile learning or m-learning. The emphasis of mobile learning is on mobility of its users that can assimilate learning anywhere and at any time on their mobile electronic devices (e.g. smartphones, tablets, mp3 players, etc) [18]. These features make it a suitable learning platform for training professionals. However, unlike e-learning on the web, m-learning innovation is constrained by the nature of the platform it experiments on. Mobile market is currently dominated by Google Android and Apple iOS⁷.

⁵<https://www.coursera.org/>

⁶<https://www.udacity.com/>

⁷As of July 2016 Android is globally used on around 65% of devices while iOS on 30%
<https://www.netmarketshare.com/operating-system-market-share.aspx>, <http://>

While Google Android platform is fairly open, Apple keeps iOS platform strictly closed and does everything possible to keep it this way for privacy reasons. M-learning app developers and innovators need to develop for both platforms and thus accept the limitations of the strictest one. This limits tools and interoperability experiments similar to those done on the web. Although HTML5 allows for cross platform mobile application development, such apps do not offer the same level of integration with operating systems as native apps (e.g. UI, loading times, internet availability ...) and might result in inferior user experience⁸.

Irrespective of constraints of the closed environment, the mobile platforms still open up new possibilities for learning innovation. Recently several m-learning platforms emerged. One is lynda.com⁹, which focuses on delivering video tutorials. Another one is the MOOC Coursera¹⁰ mobile app, which offers just a viewer to their university courses designed for desktops and laptops. Currently available mobile only solutions include smart.ly¹¹ offering quiz learning solution, Google Primer¹² focusing on designing new UX experiences that feel rewarding to the user, and DuoLingo¹³ for language learning using behaviour technology elements.

M-learning content also needs to be tailored to smaller screens and input techniques for such devices. The increase of high learning ability can be achieved through making the content bite-sized [33] (also called MicroContent) and designing the environment of the mobile screen to contain the material relevant only for the task at hand (MicroLearning). The prefix “micro” in these terms refers to content as well as time available for learning¹⁴.

www.kantarworldpanel.com/global/smartphone-os-market-share/

⁸MobileSmith. Janna Badalian. HTML5 vs Native: The Debate is Over. May 20th, 2015. <https://www.mobilesmith.com/html5-vs-native-debate-is-over/>

⁹Lynda. Online video tutorials and training: <http://www.lynda.com/>

¹⁰Coursera. Free online courses from top universities: <https://www.coursera.org/>

¹¹Smart.ly. Online MBA & Business courses: <https://smart.ly/>

¹²Google Primer. Google Marketing lessons: <https://www.yourprimer.com/>

¹³DuoLingo. Language learning: <https://www.duolingo.com/>

¹⁴<http://microlearning.org/>

This concept allows learners to learn in small quantities, and “in between” when time permits [7].

For achieving a learning routine in small quantities and “in between”, the omnipresence and mobile connectivity become indispensable features of mobile technologies. This enables the system to tactically trigger learners and condition them for daily learning behaviour, both essential elements of a good learner retention. Systematic triggering of users originates from basics of behaviourism and has been researched as applied behaviour analysis by Skinner [64] in the first part of 20th century and later in combination with computers as persuasive technology (captology) by Fogg [25].

Mobile e-learning thus provides a suitable platform to study different methods that strive to achieve a desired engagement, retention and completion of learning courses for today’s professionals. While content design and its sequencing is as important (also partly described in Chapter 3) as triggering and persuasion we limit the research scope to applying persuasive technology to the triggering part of the learning system. For this purpose, a mobile e-learning platform for microLearning has been developed and deployed at four different global corporations and used by 300 knowledge workers. The aim of the study presented here is thus focused on how retention, engagement and completion of the learning journey can be achieved through persuasive technologies.

The work presented is structured as follows: Chapter 2 presents literature on e-learning with an emphasis on mobile e-learning, Chapter 3 provides the design guidelines derived from persuasive technology, Chapter 4 describes the method used to capture users’ data, Chapter 5 presents the results and Chapter 6 the discussion of these together with implications for design and research.

Chapter 2

Literature review

The idea of ever-changing world and systems that constantly need to adapt and be flexible to be able to meet the requirements of such environment has been popularised in 1973 by Donald Schön in his highly influential book “Beyond the stable state” [61]. The argument was that the stability is a dynamic property of the systems and all involved in the social structure of each system work hard to keep it stable. In systems such as corporations the stability can be achieved through organisational learning (on the individual, group, organizational, and interorganizational levels), which is a key process that enables the flexibility and adaptation for the business to be successful.

These ideas of organisational learning were furthered by Peter Senge in the 1990s [62, 63] who proposed five conditions that need to be in place for organisational learning to be successful, organisations to be able to adapt to their environment, and to be able to change and innovate in anticipation of changes. These five conditions are: (i) system thinking (understanding the connections between all parts of the system, interrelated actions and the whole pattern of change), (ii) personal mastery (the ability of individuals to approach their life by committing themselves to lifelong learning and progress), (iii) mental models (the ability of individuals to change their shared mental models of the company, their markets, and their competitors), (iv) building shared vision (the capacity to build a shared vision of organisation’s

future), and (v) team learning (the capacity of team members to pursue a dialogue and collective thinking).

Organisational learning as viewed by Schön and Senge is the key competency for organisations to continuously and purposefully transform and maintain competitive advantage (stable state). It is an ongoing spontaneous process, embedded in unplanned everyday activities. The corporate world in the USA got inspired by these thoughts in the early 1990s generating ideas and discussions on how to incorporate learning occurring in individuals into a broader knowledge base valuable for the organisation [9]. In pursuit of this goal organisations began to focus on knowledge management — the activities associated with creating, capturing, retaining, sharing, disseminating and effectively (re)using organisational knowledge to achieve organisational objectives [19, 50].

Despite the initial excitement and promises of corporate learning, it has not achieved the predicted results in the corporate world. It achieved some levels of the ideal, but practical application within organisations was limited [9]. Nevertheless, corporate learning is still regarded as a key to corporate survival and competitiveness. The increase in corporate training budget by 15% in 2013 after the latest recession is one proof of it. Furthermore, rather than the lack of workforce American companies face the lack of new skills, especially in fast-paced changing IT industry and the corporate world [55].

2.1 Mobile learning

Corporate learning still strives towards the ideal of learning as an ongoing spontaneous process, embedded in unplanned everyday activities as delineated by Schön and Senge [61, 62]. Information and Communications Technologies (ICT) have provided a new way for delivering learning content to individuals and groups (two primary units of corporate learning). It has elevated teaching and learning from physical location and face-to-face classes in a way that no other technology has done it before. While LMS and MOOC

can hardly secure the ideal of corporate learning, the ubiquitousness of mobile internet and omnipresence of mobile devices, can provide the learner with the ability to assimilate learning anywhere and at any time [56].

Learning on mobile devices has gained several terms such as mobile e-learning, mobile learning, m-learning and is sometimes equaled to ubiquitous learning (e.g. as in [56]). Mobile e-learning definition evolved as its field of research expanded with ever evolving technology around it. Some researchers see mobile e-learning as a subset of e-learning with certain characteristics that are not typical to all educational technology (e.g. ubiquitousness, omnipresence, microLearning). Others see m-learning as an independent discipline while a third group sees m-learning as “a lateral move in the distance learning universe” [18].

The attributes most often associated with m-learning in the literature are (personal) handheld devices or technology, the way to deliver teaching and learning or pedagogy, mobility of the devices that allows pursuing learning anytime and anywhere or context, and the omnipresence of these devices or ubiquity [56, 18, 10]. Newer definitions stress out the social aspects of m-learning — “learning across multiple contexts, through social and content interactions” where context refers to the way we learn (formal, self-directed or spontaneous) and to context aware or neutral content [36].

As seen from the definition evolution, mobile learning community has demonstrated that m-learning can extend, enrich and enhance the traditional learning in many ways. Traxler for example [67] lists five such ways: (i) contingent mobile learning and teaching, where learners can react and respond to their environment and their changing experiences (e.g. gathering and processing data in situ on the field trip), (ii) situated learning, where learning takes place in surroundings that make learning meaningful (e.g. learning about fish biodiversity whilst at sea), (iii) authentic learning, where learning tasks are meaningfully related to immediate learning goals (e.g. doing drug calculations on hospital wards), (iv) context-aware learning, where learning is informed by the history, surroundings and environment of

the learner (e.g. learning in art galleries, botanical gardens, museums or heritage sites), and (v) personalised learning, where learning is customised for the interests, preferences and abilities of individual learners or groups of learners.

2.1.1 Mobile Learning Content

However, not all professional training can be delivered using all the above mentioned possibilities. Examples of suitable content for mobile learning are: leadership, coaching and management courses, design thinking and onboarding. Each is explained in more details below.

Leadership, coaching and management courses These courses (e.g. Leading Others [29], Managing Millennials [24]) are a good fit for mobile presentation as they could be designed as a feed based news system such as Twitter¹ or news channels, but presenting curated content in a carefully sequenced way providing a fairly strong continuous mobile learning resource. Companies are not always necessarily interested for the employees to become experts in the certain topic, and such courses enable them to familiarize with certain subjects, to collaborate better with outside contractors and partners.

Design Thinking Topics like Design Thinking are especially good fit for collaborative learning within groups of up to 50 people [71]. Group can be presented with a common challenge which they have to journey towards by learning more about the core topic. Along the way they can collaborate on open questions via chat and present the possible solutions with photos taken on their mobile device. Learners can then get feedback on their proposed solutions and as a group grow the solution in a promising direction based on each other's feedback.

Content Creation Mobile devices also present themselves as a really good fit for fast and simple mobile course creation. One special case where

¹Twitter Microblogging system <https://twitter.com/>

this can be applied are onboarding type of topics. In onboarding courses usually parts of the building, offices and workflows are presented, which can be quickly captured via mobile cameras and then social features can be used to present oneself to the community and ask for additional help with onboarding details. Although onboarding courses are not a good case for developing the habit of learning, mobile devices should not be discarded from the content creation aspect.

If looking at these examples it is clear that not all of Traxler's possibilities can be exploited for the given content. For example, onboarding can take advantage of situated, authentic and context-aware learning coupled with social interaction (but it is not suitable for triggering and long term engagement). While for the other two situated, authentic, contingent and context-aware learning can not always be used to their full extent; if at all. For example, leadership courses can hardly make any use of context-aware and situated learning on a field trip. Nevertheless, such content can take advantage of personalised learning. It can be argued that the quality of the content and the way it is presented (e.g. in context, situated, contingent) is very important to keep user motivated once they have decided to start studying as well as to continue the learning journey. However, the professionals have rarely time to afford and can not always see immediate benefit; thus motivating such users is of high importance for the corporate world.

2.1.2 User Studies of Mobile learning in Corporate World

In contrast to studies in education sector, studies completed in corporations rarely come to the public availability [3] and only sparse descriptions of e-learning ventures come to light. For example, MOOC has been recently studied at Google where 6500 people signed up for a machine learning course. The study description delineated the future work on longitudinal changed behaviour after (and not during) the course has finished (e.g. committed

lines of code referring to machine learning function calls thought in the course in time) [3]. Another example is Walmart, which partnered with American Public University to offer their employees a desktop based online education programme for leadership skills and grant college credits towards a degree².

There are also some m-learning corporate stories known. In 2004, Capital One addressed the issue of employees finding it difficult to attend traditional training courses during the work day, by distributing audio players with preloaded podcasts to 30 users. It then expanded the user base to 250 who served as early advocates in 2005 and until 2007 distributed players to approximately 4000 employees [13]. According to authors, the m-learning experiment gained high acceptance throughout the company. Users were even encouraged to use players for their personal content and were offered a discount when buying such content as the project also aimed at boosting morale among employees and increase retention rate. Several studies of health students and health practitioners also reported on usefulness of Personal Digital Assistant (PDA) for a variety of tasks (such as schedulers) and informal learning through resource foraging (clinical guidelines, medical dictionaries) [59, 40]. In addition, it was reported the use of these devices enhanced productivity while reduced stress and the risk of error.

While poor user retention rates of MOOCs are well known thanks to universities running such courses willing to provide data and gained insights into the problems of dropout, we can rarely obtain such data from the corporate world. Studies and mobile learning stories from the industry rarely report on learning retention and completion rates and are mostly presented in their initial phase and as success stories. Nevertheless, we can assume a similar situation in self-directed mobile learning and that, whatever the e-learning technology used, organisational learning faces similar problems of motivating and retaining users.

²<https://www.apus.edu/walmart>

2.1.3 Mobile Learning Research Gaps

The majority of the literature on mobile learning focused on effectiveness and mobile learning system design, with surveys and experiments as the primary research method [73], on devices, learning outside classroom, and on mobility [36, 25], on pedagogy and technology. While most of the research and development was being “proof-of-concept, project-based, fixed-term and small-scale with little consideration of how to embed, sustain or scale up” [67], dominated by small-scale short-term descriptive case studies, with little evaluation and reflection [17], lacking evaluation of learning, the learners, and the success or failure with m-learning [18].

Several shortcomings of the mobile learning have been signaled in the literature by several researchers, which have been summarised in [36, 25]:

- a lack of explicit underlying pedagogical theory,
- a lack of transferable design frameworks,
- a general lack of evaluation of the projects,
- a lack of longitudinal studies,
- a lack of explicit student and lecturer support and scaffolding,
- a lack of awareness of the ontological shifts.

We are adding to this list a lack of studies on how to motivate users to pursue a mobile learning journey or how to keep them returning to the learning content in the long run. With the exception of social interaction, there is not much literature about it. Social aspects such as fostering focused collaboration and blending online tasks with traditional face-to-face conversations were listed among proposed solutions for lessening MOOC’s dropout [51]. Even current models of e-learning effectiveness take into account the importance of social presence. For example, in a study of 345 users the course interaction and social presence [11] manifested in overall higher course performance, satisfaction and instrumentality [37]. Similar results have been

shown in other studies with the level of individual and social support affecting e-learning effectiveness when it is being adopted [48], and the ability to remotely collaborate with other peers affecting motivation to use e-learning and overall satisfaction [60].

As mentioned in the Introduction, this study is addressing evaluation of m-learning platform within the context of the corporate world. In order to overcome some of the aforementioned shortcomings, we plan to conduct longitudinal studies focusing on learners' retention, and course completion. This gap is addressed through the use of persuasive technology approach to build a habit of learning.

2.2 Persuasive technologies and learning

In the last decade technology has been used to persuade and motivate people towards various beneficial behaviours. M-learning certainly has the advantage that is always on the reach and users can use it also when other e-learning technologies cannot be used (e.g. on the subway while commuting to or from work). This constant availability can also be utilised as a persuasion tool. There are several ways in which this can be achieved. The conceptual core in such endeavors is the use of technology aimed at affecting users' psychological attributes (e.g. attitudes or motivations) to affect behaviour [34]. However, for a technology to be actually called "persuasive", it needs to be intentionally designed in order to guide the user towards a desired attitude or behaviour change [53].

One popular concept is implementing game mechanics to education — not just the rewards in points and badges, but building "the sense of engagement, immediate feedback, sense of accomplishment, and success of striving against a challenge and overcoming it" [38]. This approach goes by different names such as "gamification" or "seductive interaction design" [1], which takes several ideas from psychology into account such as [38]: (i) status: we constantly assess how interactions enhance or diminish our standing relative to others

and our personal best, (ii) feedback loops: we are engaged by situations in which we see our actions modify subsequent results, (iii) achievements: we are more likely to engage in activities in which meaningful achievements are recognised, (iv) appropriate challenges: we delight in challenges, especially ones that strike a balance between being overwhelming and being boring, (v) appeal factor: we are engaged by and more likely to recall things that appeal to multiple senses, and others.

Similarly, ideas from persuasive design can also be used to reinforce and increase a desired behaviour change, feelings, or thoughts about an issue, object, or action [25]. Persuasive technologies have been categorized in terms of whether they are intended to form, alter, or reinforce either attitudes, behaviours, or an act of complying [53]. Based on Fogg Behaviour Model (FBM, see Figure 2.1) in order to achieve the target behaviour, the user (i) must be sufficiently motivated, (ii) have the ability to perform behaviour, and (iii) be triggered to perform such behaviour [27]. Trigger must happen in the place where motivation and ability is high enough for the sought after behaviour to happen.

The concept of trigger can take different forms such as cue, prompt, call to action, request, etc. and can be either extrinsically (such as an email, SMS or alarm clock) or intrinsically (such as passing the kitchen and remembering the thirst) driven. Depending on user's context FBM differentiates three types of triggers: Facilitator, Signal, and Spark. When designing persuasive technologies, appropriate extrinsic trigger needs to be selected to match user's context combined of motivation and ability. Triggering as described for persuasive technology has a possibility to positively affect Senge's [63] conditions (at least those depending on users) for successful organisational learning such as: personal mastery, (shared) mental models (of the company, markets, and competitors), building shared vision (of organisation's future), and team learning.

Persuasive technologies have already been used to improve retention in mobile learning. An early large-scale longitudinal study from 2005 reported

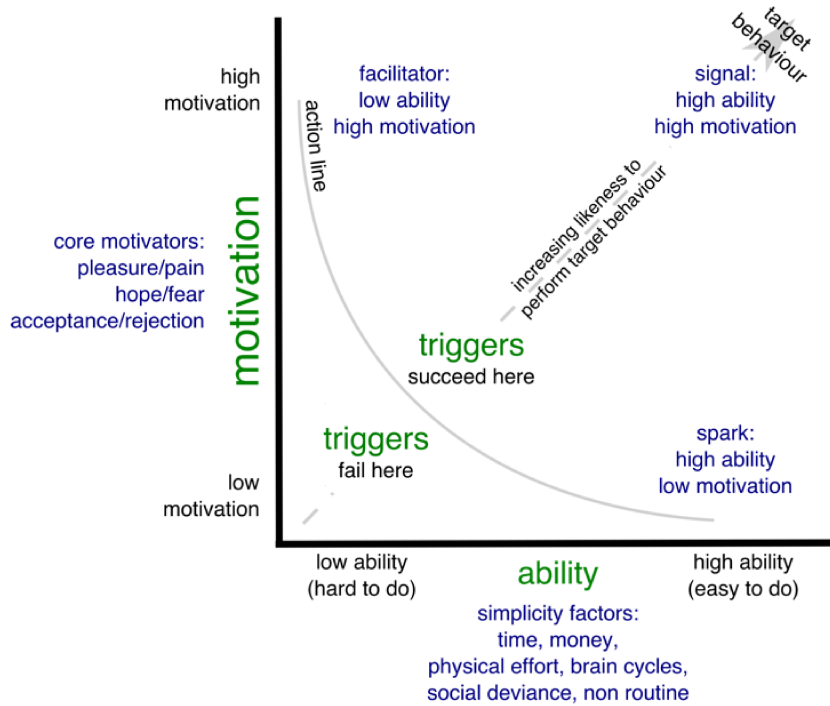


Figure 2.1: Fogg Behaviour Model depicting the relationship between motivation, ability and triggers (Compiled from [27] and <http://www.behaviormodel.org/>).

that m-learning itself acted as a motivational factor and contributed to higher retention rate of at-risk learners of which one sixth have been at risk of dropping out of education while nearly half already had [4]. A more targeted persuasion has been put in place by SMS intervention at the self-regulated learning for an information system introductory course at a university level [31]. The study reports on a positive impact of persuasive SMS on students' learning and on improved self-regulated learning effort. Students who received SMS intervention performed better than students who did not, which was true also for high risk students. Other studies of SMS targeting in higher education investigated supporting and guiding students with SMS towards independent self-management with positive acceptance [65], reported on promising results of learning new words through SMS text mes-

sages [14, 16], and studied a positive impact of SMS on reducing academic procrastination [20].

Large majority of m-learning studies focus on university students. There are obvious reasons for this: students are readily available to researchers, higher education institutes and researchers are often early adopters of new technologies for teaching and learning. Furthermore, researchers are also eager to present and expose data from such studies. On the other hand, corporations have no incentives to reveal their internal data about L & D results, there is always a risk of intellectual property leak as well as bad publicity. While university students devote large proportion their time to studies, professionals rarely have such opportunity. As such, the knowledge about how to persuade professionals to complete started learning journeys and how to trigger them towards habitual learning is of high value and importance.

The study presented addresses the lack of studies about persuasive technology triggering principle for mobile learning in the corporate world. When deciding to embark on a mobile learning application development journey we deliberately headed into learning behaviour experiments that could be facilitated by mobile platform omnipresence (assuming that learners have sufficient motivation and ability). The continuous presence of mobile devices and the ability to randomly trigger users furnished a possibility to explore how this could be exploited to reinforce learning habits. The study thus offers the results of these experiments.

Chapter 3

Method

The aim of the study is focused on learning completion using persuasive technology triggering approach to build a daily habit of learning. The main research question is:

- Does the use of triggering as a persuasive technology principle improve professional training completion of m-learning courses and encourage adoption of habitual learning?

A habit is described as a routine of behaviour done regularly or repeatedly. We characterise a daily habit of learning as having a uninterrupted streak of at least one learning action in the system per day. Learning action is defined as engagement with any of the learning modules (presented in Application design chapter). The desired behaviour of daily learning should be completely habitual and not induced by any triggering.

To answer the research question and test what and how triggering contributes to habitual learning as described above we have chosen “Action research cycle” — an iterative version of a reflective process of progressive problem solving called action research. Its purpose is to solve a particular problem within an organisation by changing the current state with introducing for example new technology, whilst simultaneously conducting research to gain new knowledge and produce guidelines for best practice [52]. An

iterative version as described in [66] comprises of five stages: (i) diagnosing (identify an improvement opportunity or a general problem to be solved at the client organization), (ii) action planning (review alternative courses of action to attain the improvement or solve the problem identified), (iii) action taking (select and implement of one of the courses of action considered in the previous stage), (iv) evaluating (study of the outcomes of the selected course of action), and (v) specifying learning (review the outcomes and knowledge building).

Our identified opportunity is improving completion rates of professional training. In action planning we considered the mobile learning as a suitable solution whereas persuasive technology triggering principle is a suitable action taking (see Literature review for more details). At each iteration we plan to take additional action and evaluate the results in the light of it. Besides, our approach could also be classed as research through design [75, 28] as the end product is a prototype artefact in that all the thinking that went into producing it is embedded within it, and in the sense that it is not simply finished, but more an artefact in perpetual beta with implications for company to take further in the development of the next version.

To summarise: the research presented in this research proposal aims at (i) building, to the best of our knowledge, the first mobile learning application focusing on triggering users to create a habit of learning based on [25, 27, 64] as well as (ii) evaluating the application in corporate environment by action research cycle process in which we gradually introduced triggers' design and measured users' completion and habit changes [52].

3.1 Experiment design

We conducted two experiments (E1 and E2) in three phases (Phase 1, 2 and 3) each lasting two months (as seen in Table 3.1). After each phase we evaluated the outcomes and adapted the triggering system accordingly. The experiments were run between June 2015 and October 2015. Due to

Experiment	Phase 1 / Group 1	Phase 2 / Group 2	Phase 3 / Group 3
	No Triggering	Triggering	Adaptive Triggering
E1 Program A	C1.1	C1.2	C1.3
E2 Program B	C2	C3	C4

Table 3.1: Experiment design with two experiments E1 and E2 each dedicated to one program called Program A and B. Each program was studied by three groups each subjected to a different triggering system.

the nature of the research question, all experiments are of between subject design type.

First experiment E1 was conducted within company C1 using a learning course we refer to as Program A. The learners were randomly selected from a homogenous group of professionals with BSc, BA or higher degree within a large Asian HR company. They were split in three groups: C1.1, C1.2, and C1.3 each of 50 users. Second experiment E2 was conducted with three different companies using Program B. Companies C2, C3 and C4 represent SMB (Small and medium sized business) Asian sales, marketing and education oriented collectives with highly ambitious professionals. Groups C2, C3, and C4 also had 50 users each.

Program A was a 30 day (30 sessions each made daily available) soft skills design thinking program created for groups to learn more about design thinking by doing, sharing and collaborating with each other on their learning journey. The course was created by a high influencer and speaker in Asian design thinking field and introduced as a complement to a short 3 day immersive course. Program B was a 30 day (30 sessions each made daily available) soft skills leadership program created for leader candidates, presenting essential values based leadership topics created by influencer and speaker in Asian leadership community and introduced as a complement to a leadership talks. Both programs were paid by company for each individual user, separate from the in-person lecture given by the curator.

In experiment E2 we wanted to verify the outcome of experiment E1

across different companies so we compared Groups of Program B conducted across companies C2, C3 and C4.

3.2 Triggering implementations

Group 1 in both experiments (C1.1 and C2) received no triggering apart from manual introduction emails in the first three days, which is a common norm with present e- and m-learning courses. Group 2 (C1.2 and C3) was subjected to triggering on email and push notification channels. While for Group 3 (C1.3 and C4) an adaptive triggering with throttling and logic was introduced.

3.2.1 Triggering

Based on the results from Phase 1 the introduction of triggers was selected as the best strategy to increase course completion percentages. Triggers were divided in four different groups based on their reach, the integration with the application and device, social component, and self inducement:

Indirect interaction triggers are daily study emails and inactivity emails that do not lead directly to the engagement with the system, but only remind user about the learning to be done.

Direct interaction triggers are daily study push notifications and inactivity push notifications. These are considered direct interaction triggers because push notifications are a system part of the mobile application which can lead directly to a learning action within the mobile learning system.

Mediation triggers [54] are those that connect users with other participants in the course and add a social motivation component to the trigger. Mediation triggers are collected across all the collaboration elements of the application and include direct chat notifications, textual

responses to the user's published answers [28] and affinity to published answers (likes) and statements in the chat.

Self initiated triggers are reminders set by the user to complete the action, which can not be completed at the moment of interaction due to time and location constraints.

One indirect interaction trigger was sent once a day at 7AM. This decision was taken based on reports that users read their email at the beginning of a working day (e.g. in [68]). One direct interaction trigger was sent at noon if the application was not opened until then. The content of these triggers tried to persuade users with simple session information or challenges such as "Start crafting your Design Challenge today", "Build your first prototype today", "Iterate your second prototype". Mediation triggers were sent out when new messages appeared in the chat, responses were published, and private messages sent.

At the end of Phase 2 the mobile application was thoroughly analyzed based on the results to identify features in the app and events on the cloud backend that could serve as triggers to try to further increase completion rates. Distributed event system and services to deliver adaptive push notifications and email triggers were implemented.

3.2.2 Adaptive triggering

One of the issues with the triggering system is overloading the user, which can result in future ineffectiveness of triggers or user's closing the triggering channels, preventing the learning system to use them in the future. The strategy to solve this problem was to adaptively trigger users based on how strong their habit of daily learning is. If the learner would habitually visit the learning journey every day, then they would receive no conditioning apart from the necessary direct message notifications, but if the system detected that a habit is weakening, it would condition them more with carefully chosen personalized triggers.

Besides triggers from Phase 2, we introduced (direct interaction) simple hooking triggers based on the the triggering design guidelines [26] stating that asking for simple actions can lead to more complex ones. Examples include notification about viewing learner’s move on the leaderboard, events on their learning journey, new likes about something they have liked, new comments about something they have commented on, etc. Once they enter the app, we can condition them to accomplish more complex actions.

The triggers are selected by the strength of habit and by the personalised influence each trigger has on the individual learner. For each learner, we calculate the `habit_score` as follows:

```
WORKING_DAYS = 5
// active_days = days in last 7 days where at least one
// learning action completed

habit_score = min((active_days / WORKING_DAYS) , 1)
```

Since this is a professional training environment, we lowered the criteria for 100% `habit_score` to 5 days out of 7 to account for working days only. Optimally, each user would have a `habit_score` of 1 until the completion of the program.

Each learner responds to triggers differently. To account for this, personalized trigger weights for each user and each of four different groups of triggers are stored. All the weights start with 0 and then increase by 1 every time a trigger is successful.

```
trigger_weights[trigger_name] = trigger_weights[trigger_name] + 1
```

Based on the results from Phase 2 we decided to consider the trigger successful if we see learner in the app within 10 minutes of receiving push notification, or 6 hours after receiving an email. We found out that if learners do not respond to these triggers in these time frames, they will most likely not respond to them at all.

Triggers need to be normalized to be distributed evenly between 0 and 1 so every escalation step of the habit score opens up more triggers. We use the most effective triggers first so the re-conditioning is successful as soon as possible.

```
// trigger_weights = map of trigger_name and success_count tuples
sorted_trigger_weights = trigger_weights.sortByValue()
trigger_rank = sorted_trigger_weights.indexOf(trigger_name)
trigger_normalized_weight = 1 - trigger_rank * 1 /
    number_of_all_triggers
```

If the learner has not appeared for GIVE_UP days we consider them lost and enqueue them in the inactive cohort. We calculated GIVE_UP days by analysing the completion percentages from Phase 2. The results showed that less than 1% of the users with a gap of more than GIVE_UP days returned and completed the program.

GIVE_UP = 9

```
// gap_days = days since last learning action completed
if gap_days > GIVE_UP
exit() // learner lost strategy
```

Every time when non-mandatory trigger tries to execute, the give up rule is checked, habit score calculated and normalized weight of a trigger is calculated. If the habit score is not optimal (1) we start conditioning the learner if the trigger normalized weight is higher than the habit score.

```
if trigger_normalized_weight > habit_score
    execute() // deliver the trigger to the learner
```

To summarize the dynamic, we start conditioning/re-conditioning the learner as soon as they are inactive for more than 2 days with most effective triggers first. If they still do not complete any action, we condition them ever stronger until the inactivity is 7 days. After that, we continue triggering for 7 more

days with all available triggers. After that we consider learners lost. The adaptive triggering system is shown in Figure 3.1 where in ideal case the triggering decreases while in the worst case it increases each day of inactivity.

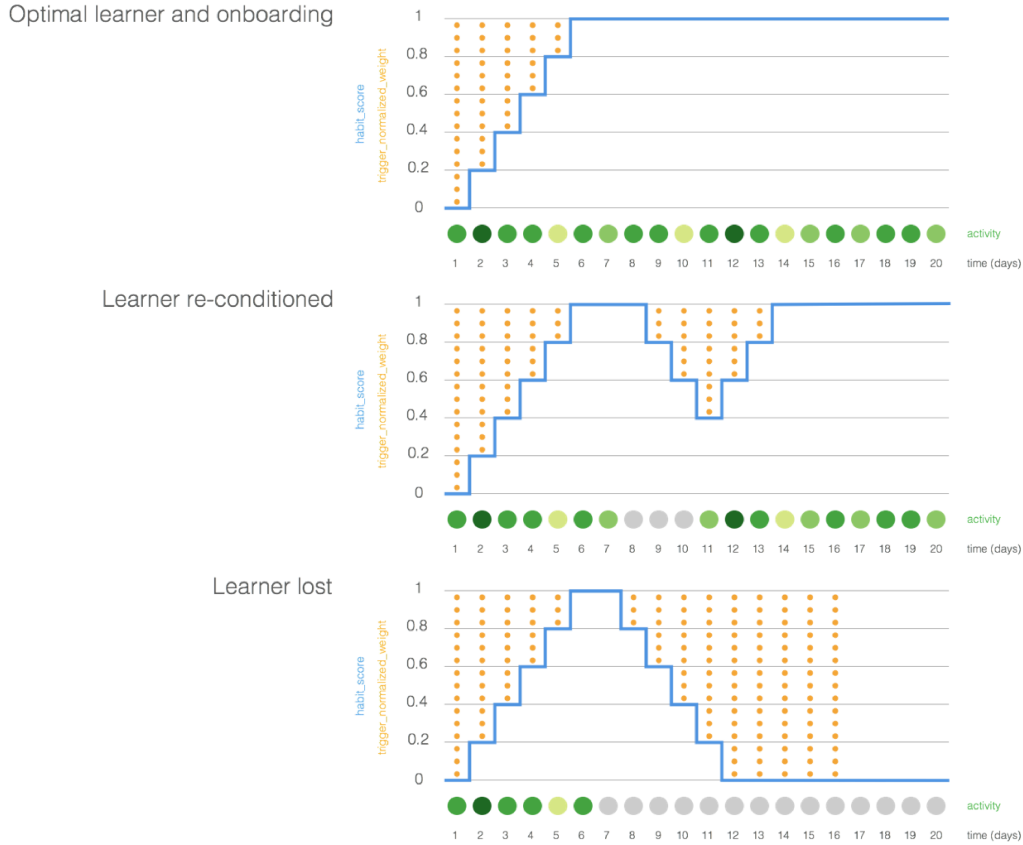


Figure 3.1: Adaptive triggering system depicting possible triggering scenarios: the optimal learner, the one who has been drawn back to learning and the worst case — lost learner.

In addition to collecting log data about application usage, users had the possibility to send researchers feedback from within application. This allowed us to collect qualitative data about all sorts of things that users wanted to share with us. Participants were also given an opportunity to have an interviews with researchers. Only a handful of people participated in the interviews while we have received over 50 of feedbacks from the app.

Chapter 4

Application Design

In this chapter a user frontend and backend are described.

4.1 User frontend

We built a mobile education application designed for sequential learning process with daily learning engagement. The learning content is bite-sized to facilitate learning material consumption in short intervals without overwhelming the user, which has been proved as successful learning approach for professionals [32, 33]. The learning material is packaged in courses called programs. Each program is split into daily sessions, which are, by design, unlocked every calendar day [33]. Each session consists of bite-sized actions that can be consumed individually in sequential or random order as seen in Figure 4.1.

Each session is uniquely identified by an icon and introduced with short text (see Figure 4.2). There is always an accessible note icon which enables learner to store short notes about what they have learnt or random remarks. The notes are synced between different devices in real-time. Chat icon opens a session specific chat which is described below in social learning section.

In the right pane the unlocked sessions are shown and allow for quick switching between them. Progress is marked by filling the blue dots along the

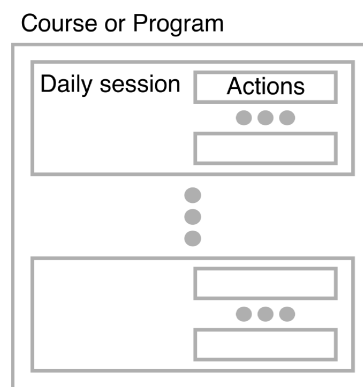


Figure 4.1: Program (course) structure divided in Daily sessions, each additionally divided into Actions.

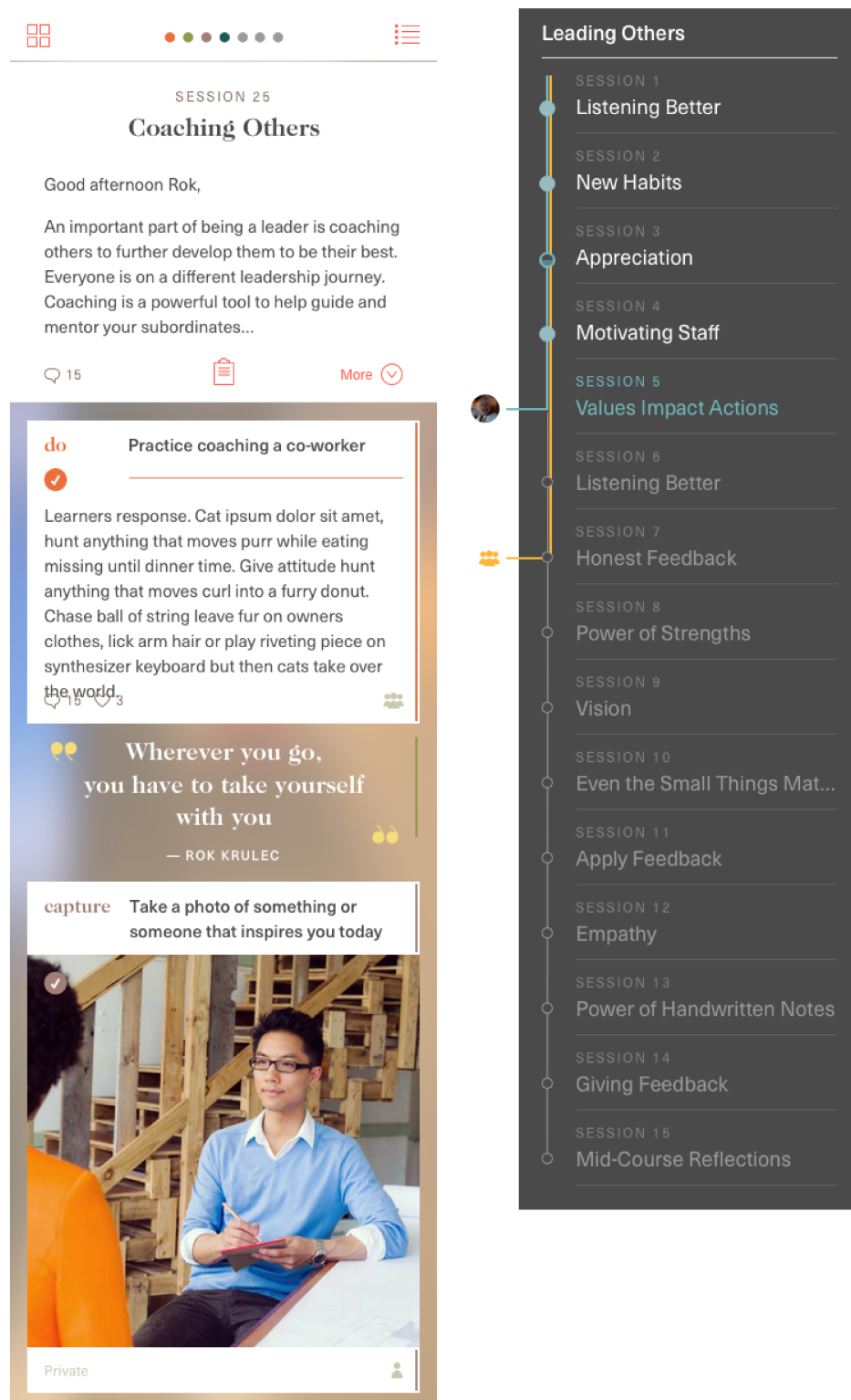


Figure 4.2: Application interface: session screen with progress drawer.

vertical line identified by user's avatar photo. Learning progress is a necessary element of every learning experience and gives learner the perspective where they are in their learning process. The team progress is indicated with yellow line identified by yellow team icon on the left. This serves as an additional motivation for the user to progress.

4.1.1 Actions

Actions (or learning) modules are presented in the feed format by scrolling down and support different content types, which are described next:

Reading

Reading action is a simple module for reading text with limited formatting. Brevity of reading material and formatting is enforced by the editing tools which ensures that the length and styling is appropriate for mobile devices (Figure 4.3).

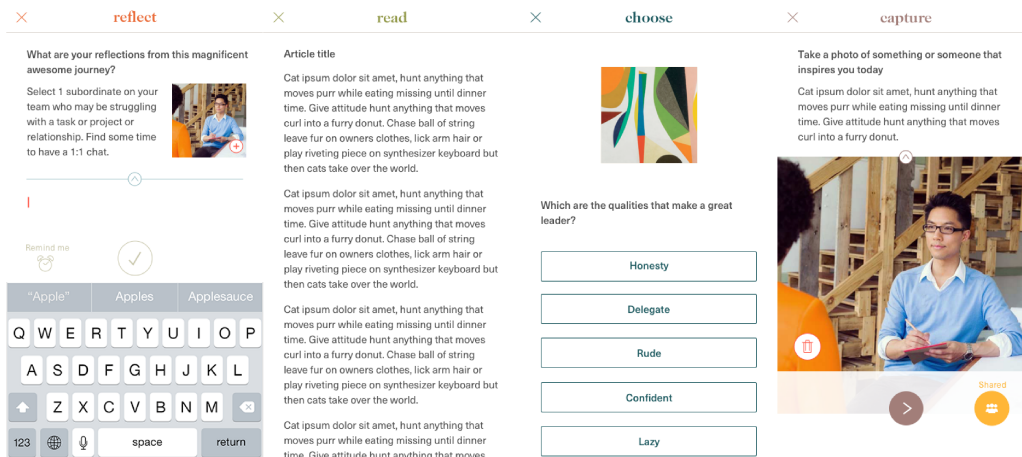


Figure 4.3: Actions: Question and answer, reading, multiple choice questions and photo capture.

Question and answer

One of the pillars of transformational/adult learning is reflection [23] and this module allows learners to gather their thoughts about and reflect on the presented issue. The module contains a text question or an image (useful for design related programs) and optional collapsible (to save screen space) description or guidelines (Figure 4.3). The curator can prepare a placeholder answer to guide the learner or make it easier for them to start answering. The answer can then optionally be shared on Journey with the learning group. Otherwise the answers are not graded or read by anyone. Abbreviated answer is also shown in the session view where learner can quickly glance through their answers.

This module also contains a reminder feature which triggers the user after the desired interval. Learners, when being presented with the question, are not always in the right state of mind or location to be able to seriously reflect on the question, despite their motivation to do so. Learner usually knows when they will have ample mind-space to do so and are being offered a predefined set of intervals for being reminded. The intervals are set to 1, 3, 6 and 12 hours as the goal is to finish each session on the current day.

Multiple choice

Non judgemental self assessment of knowledge gained is facilitated by a multiple choice module (Figure 4.3). Self-assessment helps students reflect on gaps in their understanding, making them more confident, and higher achievers [74, 57]. The module contains a question, collapsible description, optional image and random number of choices. Each choice is marked correct or incorrect in the curation process and optionally additional information is added for why each of the options are correct or not correct.

Internally/externally opened web link

Knowledge is often curated from trusted external sources and this module enables curator to include such sources. Depending on the web resource compatibility and copyright issues the module can open the web page inside the app in an embedded web view or outside in the external web browser. From design perspective an internal web link is preferred as user does not leave the app and has a higher chance for continuing the learning process.

Authenticated web link

Native mobile app distribution is a very slow process due to a long pipeline from design to the actual appearance in the app store. To enable a possibility to quickly prototype new module types, the authenticated web link module calls a web link with user authentication credentials. The module looks the same as internally opened web link but allows us to then authenticate the user within the app on the web and offer embedded functionality of a web app. This type of prototyping is the orders of magnitude faster than developing native app code. When prototyped module is successful in the wild, it can be integrated in the app.

Photo capture

Capturing a photo of something user has sketched together or made a prototype is a great reflection tool (Figure 4.3). All the captured photos can then optionally be shared on the study group journey where other learners can give their feedback in the form of text and likes. Captured photo is also shown in the session view where learner can quickly glance through their answers.

Audio

Another medium covered is audio. It is appropriate for distributing podcasts and other material in the form of audiobook or music.

Video

Video has spawned a whole online education revolution and it has been a “first class citizen” since the beginning (see Literature review). Videos are converted to mobile-friendly formats which are supported on most of Android and Apple devices and are then served via Content Delivery Network to the endpoints (Figure 4.4).

Quote

Inspiring and reflective material which breaks the monotonous learning sequence is presented in the form of quotes. Besides visually breaking the often boring list of actions, this module is also shareable to social-media which serves as a possible marketing channel.

Image

Image module facilitates visual type of programs like design thinking and art (Figure 4.4). Often image bears information, which would be too time consuming to put in a written form (e.g. infographics, information visualisation).

Rewards

To reward users after completing more time-consuming actions or completing the whole session of the program, the rewards have been implemented. They show up as an image with an encouraging text composed by curators.

Certificate of completion

When learners complete 80% of the actions in the program, they unlock a certificate of completion, which is signed by the program curator and the learner’s sponsor company (Figure 4.4). Learners are then issued a short URL link and are encouraged to share it to their LinkedIn¹ education profile

¹LinkedIn a business-oriented social networking service <https://www.linkedin.com/>

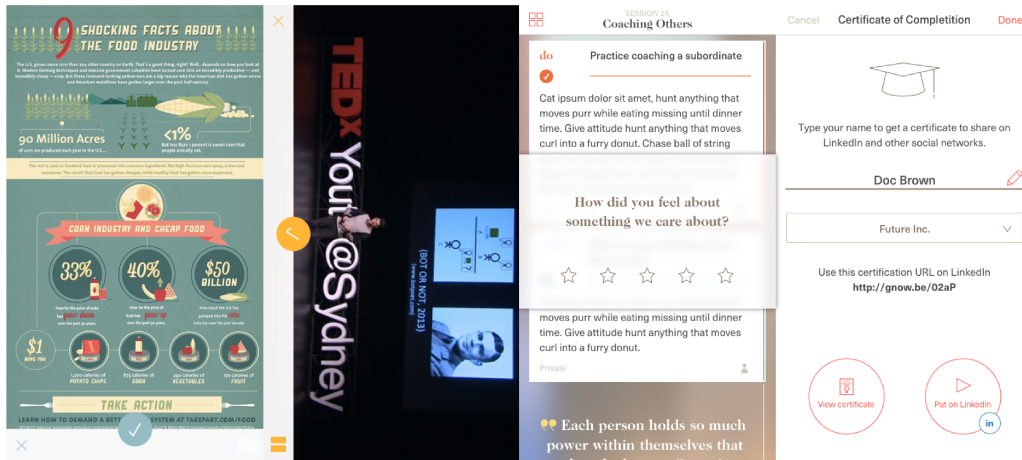


Figure 4.4: Actions: image, video, rating-assessment, and certificate of completion.

and their resume. On the session view, the number of actions needed to complete to unlock the certificate is indicated.

Rating - Assessments

In social learning it is important to enable learners to give feedback to each other and facilitate discussion, which many times manifests itself as a group problem solving [47]. This adds an experience and interpretation factor to the learning material which broadens and strengthens learning. Furthermore, the learning group is clearly identified so the viewer understands, which context their actions will be visible in (including some statistics to encourage sharing).

4.1.2 Social learning

In social learning it is important to enable learners to give feedback to each other and facilitate discussion, which many times manifests itself as a group problem solving [47]. This adds an experience and interpretation factor to the learning material and broadens and strengthens the learning. Further-

more, the learning group is clearly identified so the viewer understands, which context their actions will be visible in (including some statistics to encourage sharing). All social features presented below can be seen in Figure 4.5.

Learning journey

Learning journey was designed in the form of time-sorted Pinterest wall. Each item shows a short assignment title and the learner's response in the form of text or image. Contributor's name is exposed to enable exposure and further communication via private messages. Heart icon represents the endorsement or liking of contributed content and is the quickest way to acknowledge somebody's content. Chat icon takes the viewer to the commenting section where they can leave their feedback or discuss the content with other in the learning group.

Tapping on the shared content takes the viewer to the detailed page which shows a larger photo or shared answer together with complete assignment and few pieces of viewer's chat feedback. Shares of the same assignment are also presented here to enable viewer to explore more of the context and serves as a tool to filter and ideate. The aim of described interface is that social activities need to facilitate effortless exploration and navigation between content and people.

Chat

Real-time communication is taken for granted with the advent of countless mobile chat apps. Mobile chat communication is a large percentage of mobile use and in learning, receiving a feedback or encouragement from the learning group is important. Custom chat component has been designed which enables real-time communication between learners in a defined group or private messages. Chat is available as a session wide chat where learners can discuss anything in combination with the current session. Chat component is also used for commenting on shared items and private messages. Name expansion with @ is implemented to enable notifications of mentioned users.

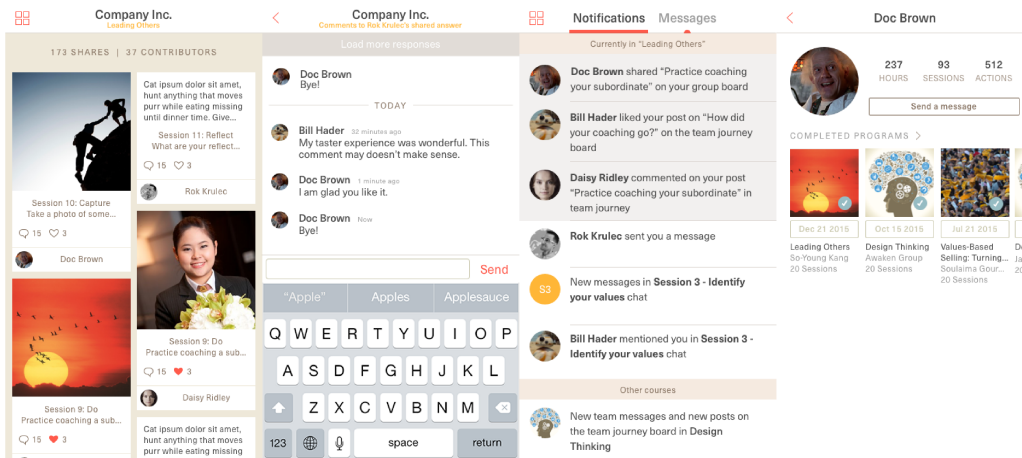


Figure 4.5: Social features: Journey, Chat, Activity, and Public profile.

Activity

Programs sometimes get big (up to 30 sessions) and it is easy to lose track of all the conversations the learner started and what is happening in the sessions where they participated weeks ago. Often, learners participate in many courses in parallel so tracking of the activities in different tracks is also a challenge. To tackle this problem notification section and private message section were created under activity view.

- **Notifications:** Notifications are a feed of the latest activity in the current program and aggregated activity in other programs in which learner is participating. Learners are notified about new shares on the journey, messages in session chat, mentions of their name in chats and affinity to their shared content.
- **Private messages:** Learners get notified in a special section about the private messages they received. Private messages are without any context so it made sense to include them as a separate list which is last-activity time sorted.

Profile

A learner profile contains a list of publicly visible completed programs and some general metrics like time invested in learning. This is a place that also leads to typical settings page where learners can edit their personal details, password, avatar photos, notifications settings and other user account details.

4.2 Editorial backend

A mobile learning program is a complex data model that needs to be populated by curators. Curators are mostly instructional designers that care about the content much more than the underlying technology. Program creation is done on a web browser using a personal computer. The creation process is guided using tunnelling approach as explained below.

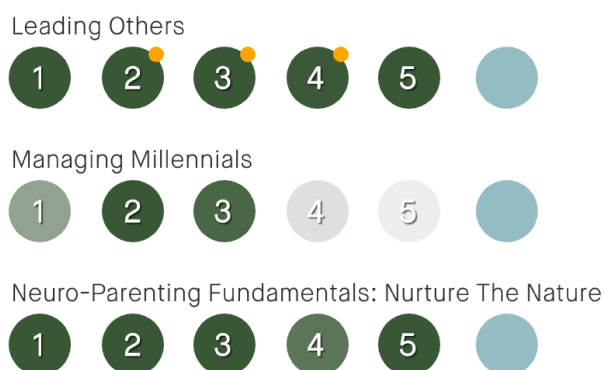


Figure 4.6: Editorial overview of program creation. Steps are color coded to show the program creation progress.

4.2.1 Tunnelling

Step by step was used to create programs, where each step was augmented only with the context needed for completing the current step. This allowed

us to create clean interfaces where instructional designers were able to focus on the content and clearly see the progress they made. Overview of the progress while creating a program can be seen in Figure 4.6.

Step 1: Program info

This step is populated with the program, curator info and certificate of completion details. It offers a preview and a way to communicate with other curators, compile notes and see the audit log of all changes to the course (Figure 4.7).

Figure 4.7: Editorial – Step 1: Program information editing form and audit log on the right.

Step 2: Syllabus - Sessions

Sessions are daily learning engagements. They are the structure of the whole program and this view facilitates curators to focus on the structure and daily assignments in general, so the program can have a flow that connects well as a whole (Figure 4.8).

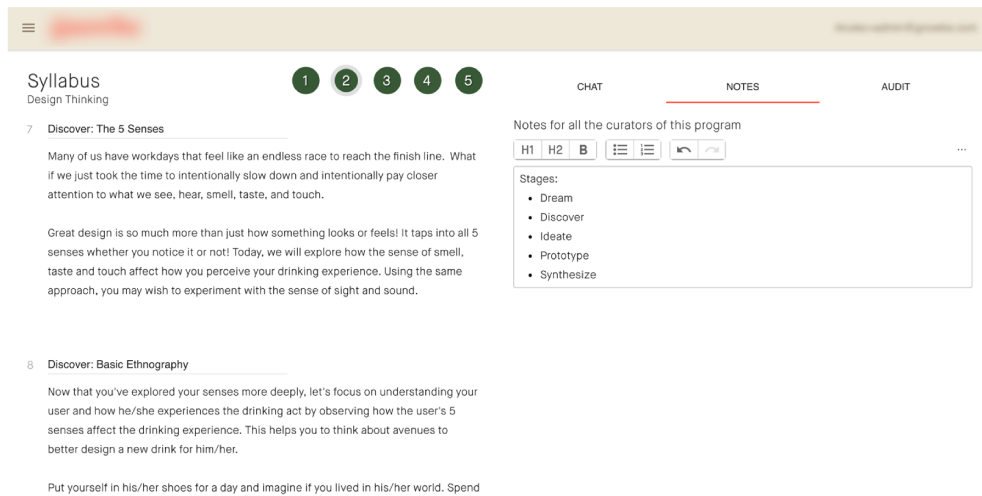


Figure 4.8: Editorial - Step 2: Syllabus design interface designed for curator focus and content flow.

Step 3: Actions

Actions are the bite sized pieces of learning content that fit into sessions. This view enables curators to insert actions, move them around between chapters and edit their details. The preview on the right gives curator a sense of how the module will look like on the phone. Both are visible in Figure 4.9.

All the editing is synced in real-time between editorial and devices, so the changes made on editorial appear live on as many devices that are currently active. This means, that curators usually have the program open on one or two of the phones and can monitor live changes on the actual device.

Step 4: Messaging

Triggering of the user always needs as much context as possible to be sustainable. And since triggering is an extremely important part of the whole learning experience, we went to great lengths to prepare the triggers that make sense. Curators must manually prepare email and push notification triggers (see Figure 4.10) for the following events:

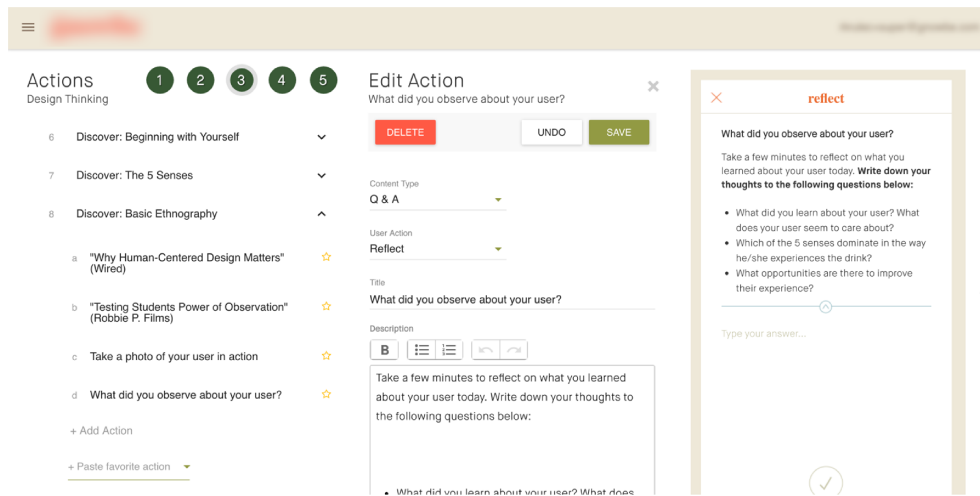


Figure 4.9: Editorial - Step 3: Action editing interface with preview on the right.

- 3rd and 4th day of inactivity push notification
- 3rd, 7th and 15th day of inactivity email notification
- Daily email and push messaging tied to the session content

Intervals were chosen experientially but this is a part when more measurements and fine tuning will be done when the number of users grows.

Step 5: Rewards and assessments

Intercepting a learner at convenient steps, like action completion or session completion and triggering rewards, email notifications or displaying assessment questions is done in step 5 (Figure 4.11).

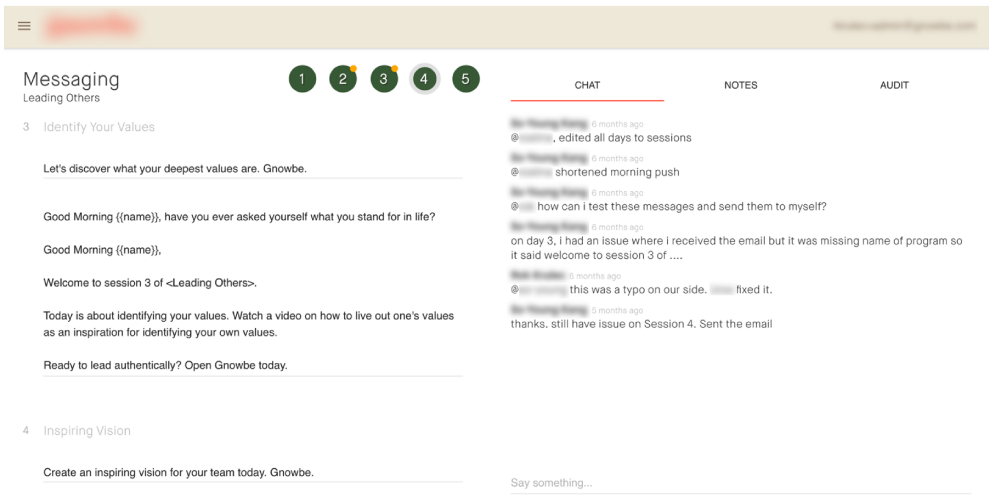


Figure 4.10: Editorial - Step 4: Showing the trigger editing and chat between the curators.

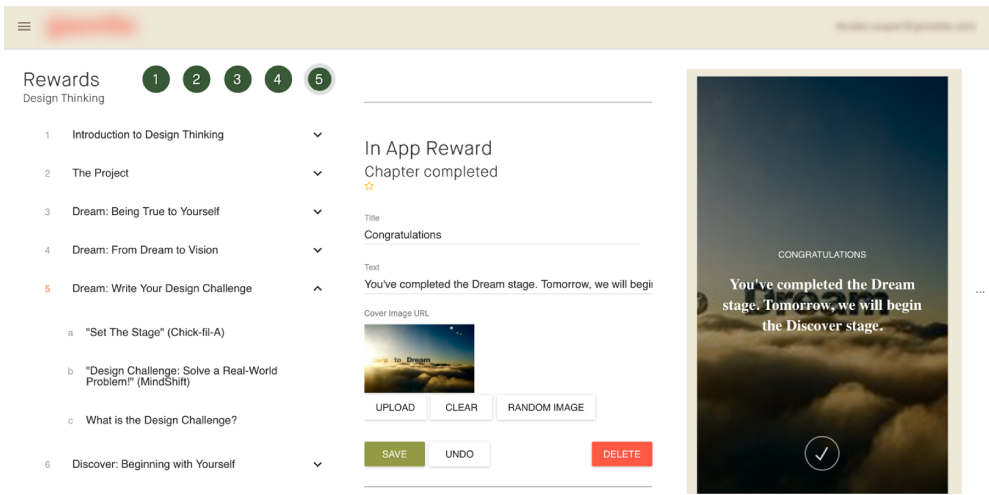


Figure 4.11: Editorial - Step 5: Final step for finishing the action or session.

Chapter 5

Results

The research question “if triggering improves professional training completion rates” has been conducted in two experiments each divided into three phases. In each phase we had 50 learners. In Experiment 1 the course theme was design and all learners were from the same company. In Experiment 2, the course theme was leadership and learners were from three different companies. In addition, to measure engagement and completion, each phase introduced a different triggering system as such: the Phase 1 included just a welcoming indirect triggers, Phase 2 has a simple daily triggering system introduced, while Phase 3 had an adaptive triggering system put in place as described in Method chapter. The results presented here are divided by Phases and finally compared between both Experiments.

Engagement can be measured in several ways. Engagement can be for example measured (i) for each user for a particular daily session (user session engagement), (ii) for a cohort of users aggregated for a particular daily session (session engagement), (iii) for each user across all currently opened sessions (user running engagement or simply user engagement), (iv) for a cohort of users across all currently opened sessions (cohort running engagement or simply cohort engagement), (v) for each user at the end of the course (user absolute engagement), and (vi) for a cohort of users at the end of the course (cohort absolute engagement). In this section we present cohort running

engagement, which we will call engagement, as we measure engagement only for sessions that users actually opened. The reason for choosing running engagements was that running engagements enable us to observe the results while the experiment is still in process.

Completion can also be measured in several ways: (i) for each user how many daily sessions they have opened without looking at engagement (user completion), (ii) for each user if they completed the whole course - opened all daily sessions without considering engagement (user graduation), (iii) for a cohort of users how many daily sessions they have opened without looking at engagement (cohort completion), and (iv) for a cohort of users how many have completed the whole course — opened all daily sessions without considering engagement (cohort graduation). In this section we are presenting cohort graduation, which we will simply call completion. Completion in our experiments is defined as percentage of learners who reached the end of the learning journey. The other measure of completion is absolute percentage of sessions that have been uncovered by users, including the ones that have not completed the whole learning journey; this metric will be called absolute completion.

To visualise the completion and engagement of users in the course we have developed a custom designed visual metric as seen in Figure 5.1. A decision was made to use a visual metric, because patterns of interest could be recognized. The metric shows how user has performed across daily sessions. This feature has been developed both for researchers to visualise the triggering system effectiveness and for the program curators to be able to visually identify which sessions have low engagement or even learner churn because of possibly incorrectly designed content.

When calculating engagement for a session, we divide all completed actions in the daily session with the number of all actions in the session. The engagement is presented on a scale of four levels. The dot is coloured in dark green when 67% to 100% of actions have been completed. Lighter green means that between 34% and 66% of the daily actions have been completed, even

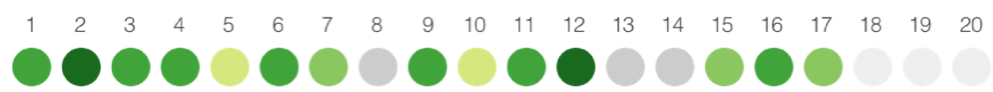


Figure 5.1: Program engagement and completion graph for an individual user for 20 sessions. Learner’s engagement for a daily session is identified by a dot. The more learning actions they complete, the darker (green) the dot is.

lighter green between 1% and 33%. If the session has been looked at but no actions completed, the colour of the dot is dark grey. If a daily session has not been looked at (learner has not opened the app at all), the dot is coloured in light grey. Optimally, users would have all dark green dots at the end of the program.

5.1 Phase 1

Two groups of 50 learners participated in Phase 1. Each had a different learning theme (Experiment 1 and 2). Figure 5.2 shows program engagement and completion graph for learners within daily sessions. Each row represents a learner while each column represents a daily session (each course had 30 sessions). The darker the green, more actions have been completed. The dark grey dot represents opened session but no actions taken and light grey dot represent unopened sessions. Users have been sorted in descending order by completion rate and engagement as a secondary sort criterion.

Only 10 people (20%) from Experiment 1 and 12 (22%) from Experiment 2 have completed the course; this means that they have at least opened each daily session and watched/read the material for that session. It can be noted that the engagement has been higher in the Cohort 2. In Experiment 1 participants have been subjected to design course that included creative mission like tasks requiring more effort. In contrast, the leadership theme to which participants in Experiment 2 have been subjected, consisted of

effortless video lectures and debate style actions. This is reflected also in comments for the Experiment 1 such as “You needed concentrated time to do the daily learning, which I didn’t have” and “Overwhelming – hated long introductions, questions are deep and require longer investment”.

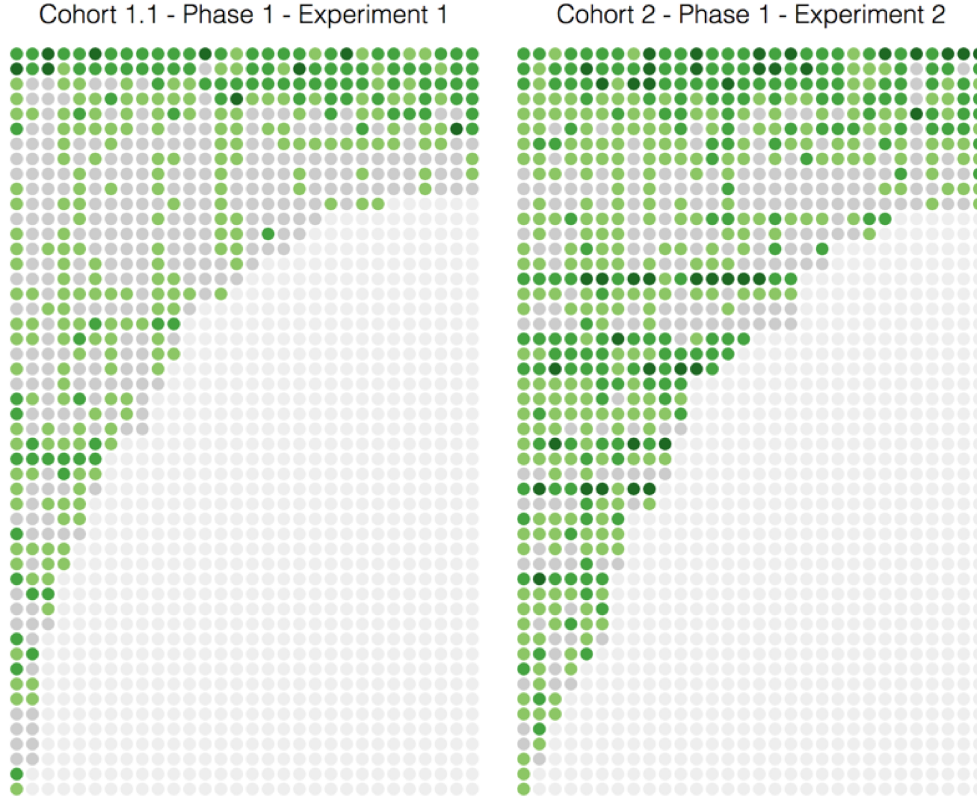


Figure 5.2: Program engagement and completion graph for Phase 1.

Moreover, it can be noticed that some daily sessions have attracted more users than others with vertical green and grey patterns. Admittedly, some learning journeys can contain harder to comprehend topics or require difficult task solving, which cannot be omitted as they might represent fundamental concepts important for the course as a whole. Nevertheless, the content of individual learning session including the tasks can always be improved in a way to attract more users or in a way that more users grasp the concepts behind and the dark grey patterns represent such opportunities. Nevertheless,

while the content of the courses has been designed by professionals it has not been in focus in this study and presents opportunities for future research.

Besides completion, engagement rate has also been higher in Experiment 2 as can be noticed by more and by darker green areas on the right graph in Figure 5.2, which means higher number of completed actions within daily session. Turned into percentages, in Experiment 1 engagement has been 5% compared to 35% in Experiment 2. This also reinforces the claim that in Experiment 1 actions have not been as demanding as in Experiment 2.

5.2 Phase 2

In Phase 2 triggering has been introduced. Direct (push notifications) and indirect (emails) triggers were sent daily to users while mediation triggers were sent whenever comments, questions, answers and messages were posted in the app. The triggering has more than doubled the completion rate. In Experiment 1 nearly half (24 or 48%) of participants completed the course and in Experiment 2 more than half (26 or 52%) completed it. The program completion and engagement graph can be seen in Figure 5.3. As in Phase 1 we can notice higher engagement in Experiment 2 with the leadership theme.

However, one of the major drawbacks of the triggering has also been noticed. Users complained in the feedback part of the app that they sometimes received up to 30 push notifications a day. Especially in the leadership course where users have been engaged in a plethora of social activities and they received notifications for all activities they have been part of. While social triggers represent an important aspect of the triggering systems as noticed in several other studies [11, 37, 48, 60], they can overwhelm users if not designed properly. Despite this design drawback, the results of Phase 2 reflect a high completion leap in respect to Phase 1.

As in Phase 1, the same vertical pattern of engagement occurred. Moreover, the same sessions experienced just content consumption (e.g. watching video or reading text) and the same sessions witnessed actions engagement. This

reinforces the stand mentioned above that non-engaging content probably needs to be presented in a more attractive way to motivate users to complete the tasks as can be also concluded from this comment from this phase “Really liked the videos. Look forward to the videos ... Disliked practising for something because it is hard to be motivated”.

The dark green dots do not present such strong vertical patterns. There are however horizontal patterns of dark green dots of individuals who tried to complete all or the majority of actions of each daily session. Even some individuals that have not completed the course tried to finish all actions within each daily session that they have opened. We have looked for reasons for this phenomena in the interviews and feedback and participants have stated that they simply did not want to invest more time into the course as

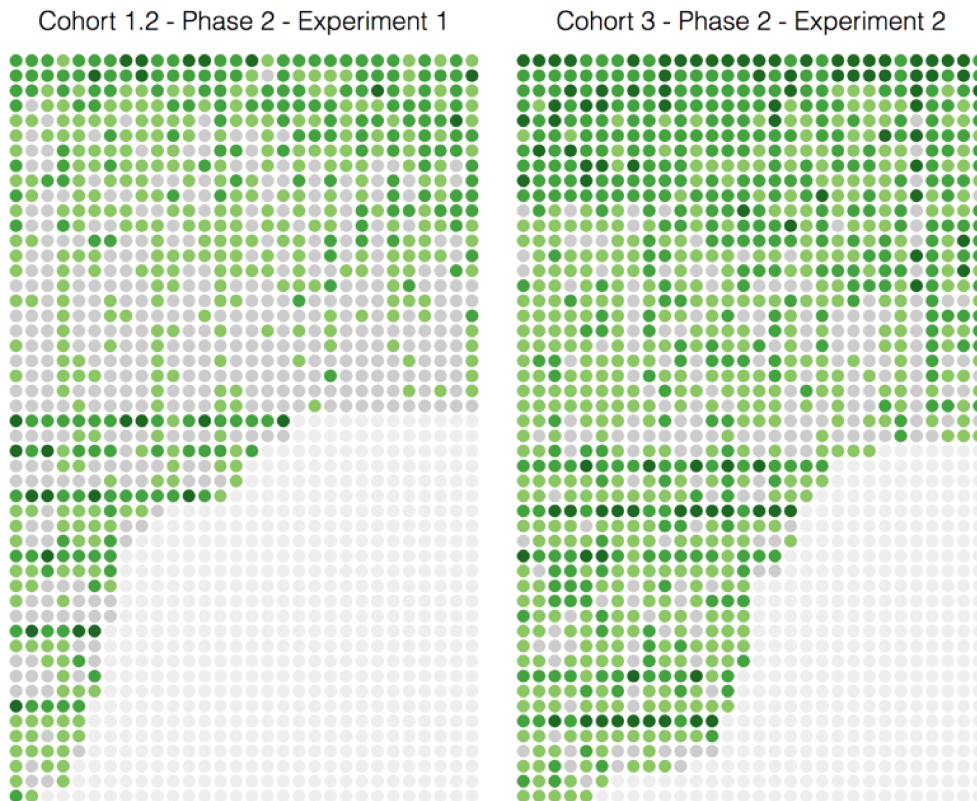


Figure 5.3: Program engagement and completion graph for Phase 2.

they did not find them enough valuable or challenging as seen for example from these comments: “Overall content seems to be valuable but too much”, “Didn’t see value”, or “Didn’t get hooked enough. What value does this course add to the larger context of my life?”.

As with completion rates, engagement was also higher in Experiment 2 of Phase 2. This is also visible by more and by darker green areas on the right graph in Figure 5.3. When turned into percentages, Cohort 1.2 in Experiment 1 has shown 28% engagement (risen by 3% from Phase 1). Compared to 41% (risen by 6% from Phase 1) engagement in Experiment 2 shows again the differences in course theme. While triggering doubled completion rates, it has not increased engagement by the same share. It looks like triggering reminded users to start a daily session while engaging needs another motivator in the course content.

5.3 Phase 3

In Phase 3 of both experiments, adaptive triggers have been introduced. Triggers have been weighted based on users’ reactions to their appearance, and then use this knowledge in the future to draw users back to the course. Compared to the completion rate jump between Phase 1 and 2, the completion rate has risen by a smaller fraction; in both experiments for 12%. For Experiment 1 the completion has risen from 48% to 56% (28 people completed the course), while for Experiment 2 it has risen from 52% to 64% (32 people completed the course).

Engagement has also gone up. It reached 31% in Experiment 1 and 47% in Experiment 2. The difference in engagement between the experiments is also visible in Figure 5.4 — the right graph has less dark grey patches than the left. The higher engagement revealed also vertical and horizontal patterns of dark green dots. It can be noticed for example that the 25th daily session in Experiment 2 has seen higher engagement than any other. Based on the comments (e.g. “Enjoyed this article’s quality, content, exercises”)

and session structure this can be both attributed to interesting topic of the session and easy actions.

What is interesting in Experiment 2 of the Phase 3 is that there is a user among them that has almost completed the course but not finished any daily action. When looking for a reason we found out that this user was a supervisor of the employees who participated a lot in the discussions of the course encouraging other participants but has never bothered to complete any action. These internal dynamics in the company can as well affect both engagement and completion rates. Nevertheless, the dark green pattern is noticeable just in one daily session and based on the Experiment 2, we could conclude that there probably has been a small effect, but results of adaptive triggering system put in place has contributed to a higher fraction of it. Moreover, the supervisor(s) have not had the insight of the engagement and completion of individual users, but could however see the engagement in the discussions.

Horizontal dark green patterns can again be attributed to different individualities and learning styles. When digging into the reasons why some people finished engaging in the middle of the course even if they engaged in full to that point in time we found similar story as in Phase 2. Users claimed that they did not find the course valuable enough for time invested such as “Useful only if interested in the topic”, or “Why should I take this course? How does this make me cooler? What value does it add?”.

Several people also stated that the content is not bite sized and it takes them up to 40 minutes to complete daily sessions, which discouraged them from continuing the course or from completing all actions as is visible from these comments “Too content heavy. Finished with it”, “Too much going on in a day”, “Content is good, each day takes a lot more than 10 minutes though - it is very time consuming so it’s hard to be consistent daily”. Users also dedicate just certain amount of time for learning and if the session required more time, they have not completed it.



Figure 5.4: Program engagement and completion graph for Phase 3.

5.4 Comparison of completion and engagement

All completion rates are presented together in Table 2. The higher jump in completion rates between Phase 1 and 2 and between Phase 2 and 3 is noticeable. Even so, adaptive triggers raised completion rates by more than one tenth, which in corporate world means a lot — each employee gaining new knowledge can contribute to the wealth of the company.

If comparing completion between experiments for each phase we see that the difference is 2% in Phase 1, 4% in Phase 2 and 8% in Phase 3 for Experiment 1. Completion has been rising slower in Experiment 1 compared to Experiment 2. As mentioned before, this can be mainly attributed to

Experiment	Phase 1 / Group 1	Phase 2 / Group 2	Phase 3 / Group 3
	No Triggering	Triggering	Adaptive Triggering
E1 Program A	10/50 = 20%	24/50 = 48%	28/50 = 56%
E2 Program B	11/50 = 22%	26/50 = 52%	32/50 = 64%

Table 5.1: Completion rates by phases and experiments. It can be noticed that rates are higher for users who were triggered — whether they received non-throttling or adaptive triggering.

Experiment	Phase 1 / Group 1	Phase 2 / Group 2	Phase 3 / Group 3
	No Triggering	Triggering	Adaptive Triggering
E1	24%	27%	50%
E2	32%	50%	51%

Table 5.2: Tail completion by phases and experiments.

different course theme and the structure of the social aspect of the course.

The above is also visible in Figures 5.5 and 5.6 where all three Phases of each Experiment are visible together. We can note that besides higher completion numbers, the tail of the cohort is moving from concave to convex in both experiments, which hints that even learners who did not complete the course, were moved farther along the learning journey in each phase of the experiment. In Table 5.2 we can see calculations of the running completion of the tails of the graphs or at users that did not complete the whole course. For Experiment 1, the running completion has almost doubled between Phase 2 and 3. While the increase between Phase 1 and 2 is barely noticeable. Contrary, tail completion of Experiment 2 has increased mostly between Phase 1 and 2, while increase between Phase 2 and 3 is barely noticeable. To make any meaningful conclusion about the contradiction we would need more experiments data, but the fact that there is a big difference in tail between Phase 1 and Phase 3 still holds firmly and supports the business decision to use triggers.

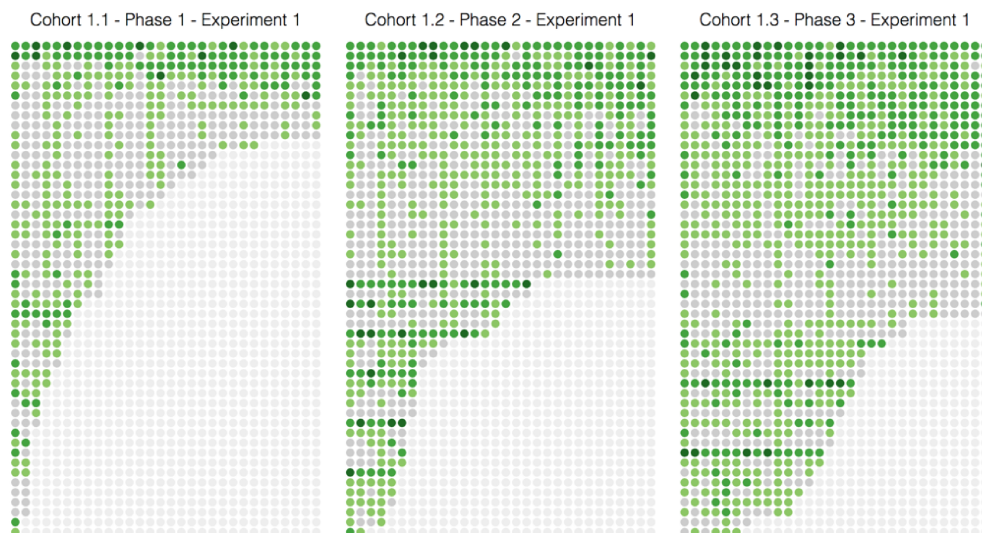


Figure 5.5: Completion and engagement rates for Experiment 1.

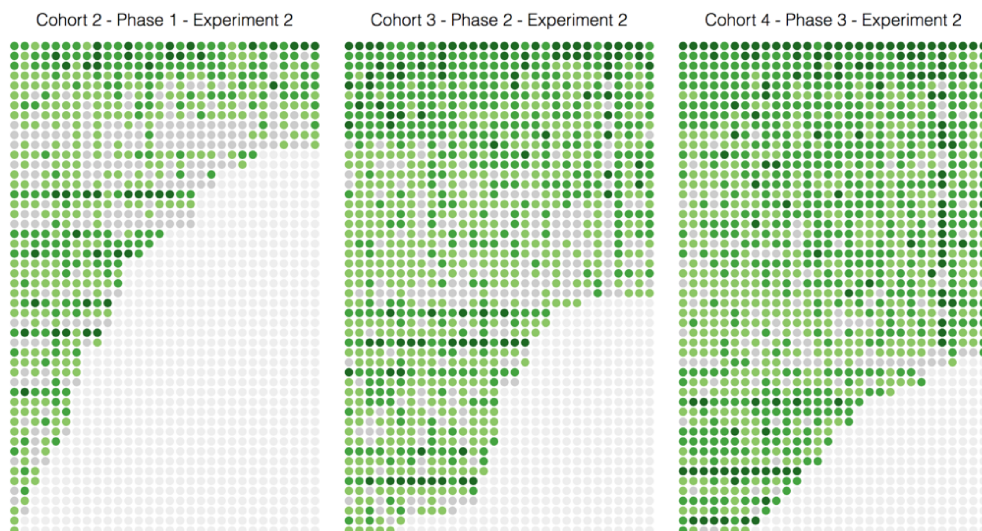


Figure 5.6: Completion and engagement rates for Experiment 2.

Experiment	Phase 1 / Group 1	Phase 2 / Group 2	Phase 3 / Group 3
	No Triggering	Triggering	Adaptive Triggering
E1	25%	28%	31%
E2	35%	41%	47%

Table 5.3: Running cohort engagement or simply engagement.

When calculating engagement for each dot in the graph, we count all the actions in the daily session and divide them by the number of actions in all sessions that have been opened by all users.

As mentioned before, the engagement is highly dependent on the type of the course material. Course curators in both cases strived to create not just knowledge acquisition courses but engaging journeys for teams to take on. There is notable increase of engagement across the phases (Table 5.2) which we attribute to introducing more social features which are amplified by triggering and were vice-versa introduced to create more triggering opportunities. The engagement increase can be visually noticed on Figure 5.5 and Figure 5.6 as a slight increase in colour saturation of overall cohort pictures. Looking at the secondary metric of running engagement is important, for the over optimization of the first primary metric (completion) should not backlash in other dimension we care about. The focus of this work is on primary metric to mostly narrow the scope of the work, but we did not completely omit the secondary metric.

5.5 Time of day usage

Every single action time engagement data for 600 users was collected between the Phase 1 and end of Phase 3 including 300 other users out of the experiment cohorts. All action completions were aggregated by hour to compile Figure 20 time-of-day usage graph. Vertical axis represents total number of individual actions completed and horizontal axis represents hour of day of

learner's local time.

5.5.1 Routine psychological states

One of the goals of behaviour design and triggering is also to tie the behaviour to one of the user's routine psychological states. We were targeting morning commute and lunch break as two possibly prominent states for learning.

To explore this aspect, we looked at the time of day usage of the app. The strategy of triggering learners is to send them a non-intrusive morning email with a summary and motivation for learning on the current day. These emails are sent out every working day, as long the user is progressing through the course daily. If the user does not use the app until noon, the more intrusive push notification with daily motivation is also sent. These two triggers bypass the adaptive triggering system completely. The triggers are always scheduled to the current local time-zone of the learner. These motivations are also custom designed by the curators and are very course specific and composed to influence motivation. We notice two spikes on Figure 20 in the mornings and lunch time that could be attributed to these two triggers.

5.5.2 Constant availability of mobile; after-work and private-time hours

After-work hours also show very high engagement, which confirms the private-time learning hypothesis. Private-time learning was also one of the value propositions to course and learning platform buyers. This fact also confirms the claim that constant availability of the mobile is penetrating in every aspect of the human awake life.

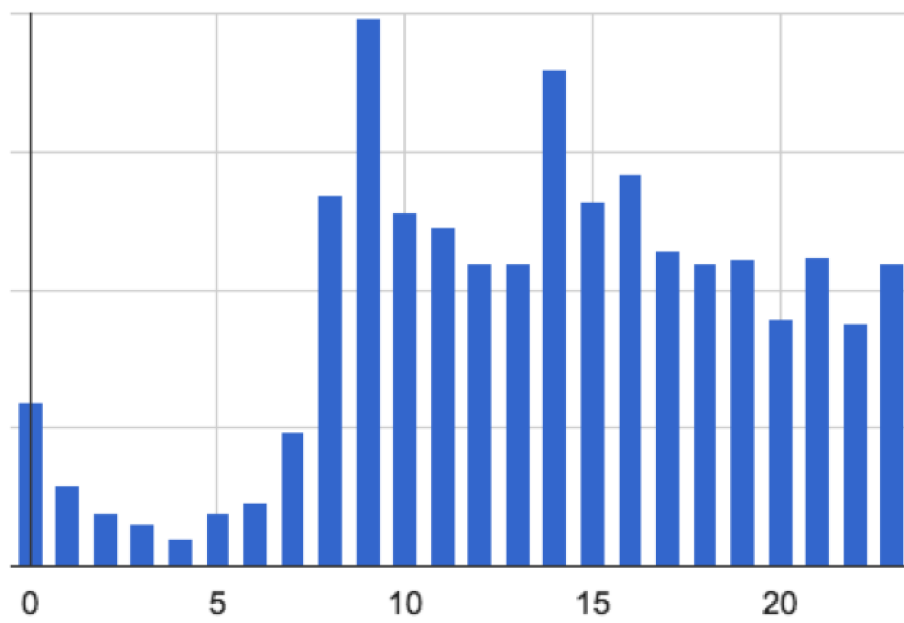


Figure 5.7: Time-of-day use (n=600).

Chapter 6

Discussion

In this thesis we presented a study about the effect of triggering on course completion for working professionals. The method adopted was action research[6], which is not commonly used in HCI field. According to some estimates, it accounts to less than 5 percent of the HCI research output, while the majority of research is done using experimental research, followed by survey and case research methods [52]. However, in recent years external funding agencies started valuing research having practical applications. For example, the European Commission in EU tends to favour Action Research-like research, while the National Science Foundation in the U.S.A. is catching up [44]. Moreover, several researchers at companies such as Google and Microsoft tend to focus on Action Research-like HCI research [52]. It is commonly used in workplace settings as it is heavily grounded in practice and intends to explore, inform, solve a problem or test a research question [70]. It was thus an appropriate method to be used in our study.

The study presented is also not focusing on knowledge retention to limit its scope. There is a vast body of literature on knowledge retention techniques from the field of learning psychology (see for example [22] for a recent review). The techniques, such as self-testing, spaced repetition, elaborative interrogation, self-explanation, and interleaved practice can be built into the content of the studying material. The application design was based on the

guidelines from the literature while the content was created by instructional designers. However, professionals need to make time dedicated to learning and triggering them to provoke this to happen (such as the action to make them look at the studying material in the first place) is an important step in the whole process, which needs to be studied in depth.

Another limitation of this study might be that courses were paid for by the companies on per user basis. Unlike many MOOCs, which offer courses free of charge (for example Coursera) and experience massive drop-outs [45, 51, 21, 9], our situation might have contributed to higher completion rates. Employees could have been pressured by employers or could have different attitude towards the courses knowing they have been paid for. Nevertheless, Table 5.1 clearly indicates that users from Phase 1, having no triggering implemented, achieved lower completion rates by half despite knowing as much about the courses as groups in Phases 2 and 3. Moreover, the groups in Experiment 1 (see Table 3.1 and Table 5.1) were all selected from the same company, which indicates that the employer had no pressure imposed on groups in all three phases.

6.1 Implications for design

The results of non-throttling triggering were promising. However, with some adaptation, personalisation and appropriation the results have been further improved. It has been suggested that personalisation can lead to greater effects than non-personalised approach in many areas. One such where this has been extensively studied and exploited is marketing [35, 2].

Personalised marketing occurs when corporations gather enough data about the user to tailor marketing to this user's preferences. Internet companies such as Amazon and eBay have been successfully using personalisation techniques to recommend what would we need next [12]. Similarly advertisement, news and trivia are fed to users based on search queries, mining emails and other cloud based personal information. Even non-internet based

companies have been exploiting personalisation such as insurance companies, tourist agencies, etc. [2]

Personalisation has been explored in educational sector as well. Is has been for example suggested that in large undergraduate studies establishing a personal contact to address students' need, interests and goals can serve as a motivational factor. For example, students who received personalised motivational and volitional email messages had shown higher motivation and confidence levels in comparisons to students who had not [42]; although, there was no difference between the two groups in study habits measured in number of hours spent studying. The amount of personalised emails received also had no effect on increase of time dedicated to studying in on-line activities and the same results were achieved whether the instructor sent two or fifteen emails [72]. However, all these studies were measuring habits of students; albeit in the second one the users were part-time students.

Contrary to the above studies, our results show that users subjected to triggering (personalised triggers, push notifications, social engagement) are more likely to spend more time on the course. There was a big difference between Phase 1 and Phase 2. The latter (non-throttling triggering) shows twice as higher completion rate (around 50%) than the groups that did not receive any triggering (except the initial welcoming and instructing messages for the first three days).

Triggers in our study were delivered via different channels: email, push notifications (also chats, questions and answers), and self-initiated triggers. While in the studies above, only email has been used to trigger learners and email is often associated with overload [69, 8], which might have contributed to ignoring it. Another possible explanation is also that students (part-time even more) have dedicated their time to study and emails just contributed to higher satisfaction and not to higher motivation or more time spent on studying. Moreover, push notifications can be considered part of the m-learning application while email is not (strictly speaking) part of the on-line environments used in above mentioned studies (LMS, MOOC).

Lastly, in these on-line environments, students could not make use of non-places, which might contribute to higher engagement (measured in time spent in the course). Despite the fact that users in our study were full time professionals and knowledge workers to whom training presents an opportunity as well as a burden (time-wise), and were not obliged to finish (as are students) the course while finishing it did not affect their position within the company, we achieved approximately 60% completion rate. Nevertheless, in above studies the completion rate have been much higher (in [72] all students finished the course successfully) as student embark on the learning journey on their own will.

6.1.1 Plan triggers

Design guidelines for triggers suggest that an effective trigger for a small behaviour can lead people to perform harder behaviours [26]. For example, when a social networking site LinkedIn sends us an email that we have not signed in for some time, they provide a link to sign in page. When we sign in, they start engage us in more activities such as endorsing friends, completing account information, etc. So triggers should not invite people to finish the whole course. Instead, triggers should invite them to accomplish simple things and later lead them to more complex actions. Planning the content of triggers is an important step in the whole process and based on the question “what is the behaviour we want to achieve (today) with the trigger and how to hook user to it?”

We have used several triggering strategies. Compared to emails, push notifications have been more effective. And most effective among push notifications were mediation and self-initiated triggers. The latter are dependent on users and we as UX designers are left with mediated and direct interaction triggers. However, as it happened in our Phase 2, triggers can be overwhelming. It has been already noted that only 6% of users respond to push notifications¹ and we have to take into account that our m-learning app

¹<http://www.adweek.com/socialtimes/accengage-six-percent-of-users-respond-to->

was also not the only one using triggers. Moreover, the number of segmented push notification is increasing as marketers have noticed that “users are more likely to respond to a message with information that directly affects them, as compared to a message that was sent to all of the app’s users”². Mediated triggers are part of this realm and directly compete with other triggers for attention. M-learning app could be treated differently by users among abundance of marketing and gaming apps, as it can help them in their careers. However, we cannot count on this.

Designing triggers can be a daunting process. Nevertheless, there are some directions that can be drawn from our study. Keeping track of how many notifications users already received is essential not to overload them. Next, it is important to select only triggers that are most relevant and that users are more likely to respond to and limit the number of these to the minimum if users are active.

6.1.2 Find out what works for every user

Adaptive triggering seems to be an answer since triggering was used only when users were not active. As mentioned at the beginning of this chapter, personalisation plays a significant role in user satisfaction. In Phase 1 we have sent personalised emails for the first three consecutive days, but this was not enough to keep users continuing the course. We have started using personalised triggers in Phase 2, which has resulted in significant completion rate difference with Phase 1. However, we have shown that just personalisation alone and plain triggering can be improved. We have started with and used the same personalised triggers in both Phase 2 and Phase 3. But it was the way we triggered that made the difference. Adaptive triggering in Phase 3 based on users’ preceded actions has proven more motivational. It is thus important to find out what works and what does not for every user individually.

push-notifications-infographic/615791

²<http://info.localytics.com/blog/2015-the-year-that-push-notifications-grew-up>

Nonetheless, such a system cannot be trivially put in place as the one in Phase 2 and cannot be used in the initial phases of the learning journey. The system needs users to take some actions first to start learning what works for them. A combination of non-throttling and throttling systems needs to run in parallel and one system takes over the other as needed: (i) throttling over non-throttling when we have enough knowledge about what is effective for a user, and (ii) non-throttling over throttling when acquired knowledge does not lead to desired results. It is the user who is (unknowingly) appropriating the triggering system to their own expectations.

This approach has proven successful in our study. Even so, the system is not faultless. At the end of the day, users are the only ones who have the knowledge of when and where they are willing to study. Our system can weight triggers based on users' reactions: e.g. a user receives a trigger of them being mentioned in a conversation and opens the app to check it out. Such trigger will be given a higher weight than other triggers that have not lead to direct interaction. Nevertheless, this user's action does not necessarily lead to studying as user may not have time available at the time when trigger was sent. We can argue that such triggers help "planting" subconscious knowledge about the app and that user will open it later to continue their tasks.

Triggering at the right place at the right time would be a holy grail but finding out these is not so trivial. A combination of looking for when users are in non-places or experience dead-time [5], and learning when and where they study to use this knowledge for triggering can provide a solution. And even if we try to send push notifications at most sensible time, we could still be wrong. Letting users to dismiss or postpone triggers to a time when learning is viable could solve this issues. And lastly, with an adaptive system such as ours, one need to put a limit in place as bombarding non-active users with push notifications can end up in uninstalling the app.

6.1.3 Bite-sized content

Mobile technologies have an advantage over other e-learning systems as they are always available even in so called non-places [5] such as trains, airports, planes, automobiles, hotel rooms etc. However, mobile devices have a smaller screen estate than personal computers and the content needs to be adjusted. In recent years, a concept called bite-sized learning has become popular in relation to mobile learning. It can increase participation of professional training; however, it poses difficulties in participating in (real-time) social tasks and daily participation [32].

While triggering doubled completion rates, it has not increased engagement by the same share. Engagement is tightly linked with the content that needs to be suitable for m-learning, relevant for the target group of users and rightly presented. The assigned actions of Experiment 1 for example demanded more effort to complete. The difference in course theme between experiments was also notable in course completion distribution and can be attributed to different content and different learning groups. Light content leadership in our case has proved more likeable than design themed content. The choice of the content suitable for the m-learning platform is thus crucial for achieving both high completion and engagement.

Crucial for engagement is also time needed to complete daily sessions. Our daily sessions have been design with the aim that they would take up to 15 minutes to complete. It has to be stated that we did not tell users how long each daily session was in order to not instil any expectations. Despite this, the majority of comments we received from users have been about the length of daily sessions. It took users sometimes twice as much time as we predicted. Also, if they have had allocated time for that session, they simply could not complete it. However, each individual can invest as much effort as desired in a daily session and as much time as desired for a particular action within a session.

Recent literature on bite-sized learning for academic staff states that 30 minutes is still considered short enough [33]. In contrast our data suggests

that this might be too long. On average our users spent 12 minutes a day in the app including all social activities and in majority of the cases they have not completed all the actions. Our initial aim of 15 minutes thus proved as a right decision despite the fact that it took users between on average 5 to 10 minutes more to complete all actions and that what took more was often left unfinished (similarly to Gray’s study [33] where promised 30 minutes often extended to one hour). Time is a valuable resource in corporate world and it seems crucial to tell users what the course demands of them in order to build trust. If users’ expectations and the actual experience (most probably negative) are different the trust is not built and users are likely to abandon the learning journey. Moreover, they may also spread a negative campaign among the peers and beyond (every user of our app has a possibility to rate it in app stores and these rates can be seen by users from other companies), which can have devastating consequence on the success of the m-learning app.

The course length is also important. Our initial choice for a 30 days’ course spread over a month and a half was based on the demands from corporate sector — longer courses are simply not suitable. However, we have opted for longest possible timeframe to be able to capture habitual changes. Gray’s bite-sized courses were a week long and it sparked different reactions from “... a bit fast and furious ...” to “... short daily tasks over a week or so definitely motivate me to plug away at it and not have a big mental barrier about participating ...” [33]. He suggests that a two-week period might be more suitable. Our data suggests that 30 days might be too demanding as well and based on several users’ feedback such as “I’d rather take two short courses than one long” we deliver 20 days courses at the moment, which proved to be more effective completion and engagement wise.

Besides the content theme, daily session length and course length, the way content is presented is also important. We have several comments about the presentation such as “please provide more video training as it is easier for me to remember”, “STOP giving so many long articles to read”, “It was

very text heavy”, “hard to read the text”, “reading on a phone is tough” and “really like these videos and motivates him to find more videos of this nature”. Yet some comments (admittedly the minority of them) depicted an opposite stance: “videos: not the biggest fan of videos”, “loved articles – wants to have note to self”. It is hard to satisfy everyone, yet our data and data from other m-learning success stories (e.g. [13]) suggest that video and audio are more suitable than text.

6.2 Implications for research

Although this study focused on triggering as one of the three elements of Fogg Behavior Model (see Figure 2.1) besides motivation and ability, the design of the triggering system as well as the rest of the application followed several persuasive technology principles [25, p255]: reduction and ease of use (reduced complexity of the content to bite-size daily sessions and actions), tunnelling (guiding user through content), tailoring and personalisation (personalised emails and pushed notifications, content relevant to careers), self-monitoring (always letting users know how further they are in the course), conditioning (motivational push notifications, emails), virtual rewards (certificates of completion), attractiveness, surface credibility (professional design of UI), expertise (content made by well-known professional motivators), etc. The choice of a mobile platform has offered to exploit further principles such as: convenience (always at hand), simplicity, social facilitation and comparison (enabling to chat, watching group progress), normative influence (peer pressure), cooperation (co-solve problems in certain courses), etc.

Each of these principles integrated into design of our mobile learning application has contributed to the overall outcome of this research. However, since the design was the same and just the triggering has changed between phases (see Table 1), we are certain that iterations in triggering design contributed to higher completion and engagement levels. Nevertheless, the triggering element has a room for improvement.

This study has shown that personalised triggering system, by assigning weights to different triggering types based on users' reactions to them, improved results of completion rates by around 10 percent compared to simple (yet personalised) triggers. This could be further improved with principle of suggestion and principle of Kairos. The former states that interventions should be performed at the most opportune moments, such as when people have the ability and motivation to respond. While the latter states that offering suggestions at opportune moments increases the potential to persuade. We have described possible directions in previous section such as: context aware triggers and their postponing. We are already working on improved triggering system and one of the future studies will measure its effectiveness compared to the old adaptive triggering system.

We admit that our aim was to build habitual learning and it can be argued if 30 days is enough to achieve this. The literature most often cites Maltz's observations that it takes "a minimum of about 21 days" to form a habit, which is often just shortened to the wrong fact that "it takes 21 days to form a new habit" [49]. However, recent data shows that it takes anywhere between two to eight months to form a new habit depending on the complexity of the habit itself as well as the personality of the pursuing individual [46].

It might thus seem far-fetched to claim that we measured behavioural changes in this study. It can be argued for example that users may have kept returning based on triggers (e.g. mediated "social" triggers have proved especially successful to draw users to the app) and not on their own. Nevertheless, we observed the drop in the number of triggers for some users towards the end of the course, which suggests that some users were creating a daily learning habit pattern. Whether this have been achieved in the long run as a part of this study is questionable and it presents another opportunity for future research. This is worth studying in particular since habitual learning can positively affect the whole learning journey or as it has been suggested that "students generally learn best when they keep a consistent

study schedule and distribute their study time evenly across a number of days” while cramming (binge learning) is not always the best learning strategy [30]. As explained in previous section, newly designed shorter courses (20 days) and sequentially assigning users to them will allow us to measure behaviour changes in learning in the long run.

Moreover, behaviour change can be measured long after the course has finished such as changes in job behaviour. Future work include training course evaluation following either summative or formative assessment at the end of the course (study knowledge retention) and long term assessment based on the four level Kirkpatrick’s model [43]. These four levels are (i) reaction or participants thoughts and feeling about the training, (ii) learning or the increase in knowledge, skills and change in attitudes, (iii) behaviour or transfer of knowledge, skills, attitudes from classroom to the job settings, and (iv) results (e.g. monetary, performance-based) that occurred because of attendance and participation in a training program. The importance of course evaluation, developing evaluative expertise and gaining organizational support for evaluation efforts have been stressed out in the literature recently [39] and our future work will add to this knowledge.

Another future research direction is also about how changes in the content affect engagement rates. The content of the courses for this study have been designed by professionals and it has not been in focus in this research. Nevertheless, content is at the core of training and it should be given more attention in the future in order to improve it. We have suggested that dark grey areas in graphs from Results chapter offer an opportunity for content improvement. This can happen either by trimming the content to a bite-size as explained in Implications for design section or more drastically change it to a more attractive form in order to engage users with it.

Engagement metrics of our study have also room for improvement. We have measured actions completed in daily sessions but have not measured if users have read or watched the introduction of each session. We have already introduced changes that measure also actual time spent on each action in

order to tune the content and measure actual engagement with it. Based on supervisor's support in one of the cohorts, we are lately also experimenting with so called internal promoters or company's community managers who are people from the company that give examples of good behaviour and share and socialize on the app.

Lastly, while we have proved that triggering with push notifications and email as a habit building strategy has positive implications on engagement and completion in training professionals in a bite-sized m-learning journey, there are other behaviour design strategies to explore which intercept learner's attention in familiar already visited places outside of the learning app; for example, getting onto learner's calendar.

Chapter 7

Conclusion

This research has focused on the use of triggering as a persuasive technology principle to improve professional training completion of m-learning courses and encourage adoption of habitual learning. Professionals have busy schedules and are perpetually delivering required results for the corporation. As such, they can rarely devote their time to learning. The omnipresence of mobile devices and thus m-learning, and the principles of persuasive technologies have proven to be a possible solution. This research provides several contributions not previously discussed in the literature.

- *The results of triggering in the context of professionals using m-learning:* While triggering has been used before in higher education to promote learning, it has not yet been explored in the m-learning for knowledge workers. Direct mobile pushing notifications tightly coupled with m-learning application provide a powerful tool to persuade users towards habitual learning. Moreover, social component in these triggers are a huge driver to application usage. However, triggering needs to be planned carefully and we have shown that adaptive triggering provides a possible solution to triggering overload.
- *The use of a variant of action research and research through design methods in corporate environment:* Designing a solution and observing

it in action enables researchers to receive hands-on knowledge of how their intervention affects the behaviour of individuals using a solution. It is only when a particular solution is used and observed in practice that we can obtain answers to: how is this solution used, it is used as expected, it has helped solve a problem, why yes and why not, what novel or unexpected usage has been observed, why have users use it in such ways, etc. While initially design has been based on design principles as described in Application design section, all additional knowledge and thinking is constantly being embedded within the app in repeated cycle with new discoveries that lead to further design decisions.

- *Visualisation of learning engagement and completion:* For the purpose of this research we have developed a novel colour-code based visualisation technique that enabled us to observe engagement with course material and completion of the course. This visualisation is a two dimensional matrix: course progression is on a horizontal axe and users on a vertical. Each dot in the matrix (graph) represents engagement of a user for a particular course session. Coloured patches within such a graph can reveal sessions that receive a lot of engagement as well as those who do not, and users who are very active and those who are not. More importantly, this visualisation enabled us to compare how different types of triggering affect engagement and completion.

Bibliography

- [1] Stephen P. Anderson. *Seductive Interaction Design: Creating Playful, Fun, and Effective User Experiences (Voices That Matter)*. New Riders, Berkeley, CA, USA, 1st edition, 2011.
- [2] Neeraj Arora, Xavier Dreze, Anindya Ghose, James D. Hess, Raghuram Iyengar, Bing Jing, Yogesh Joshi, V. Kumar, Nicholas Lurie, Scott Neslin, S. Sajeesh, Meng Su, Niladri Syam, Jacquelyn Thomas, and Z. John Zhang. Putting one-to-one marketing to work: Personalization, customization, and choice. *Marketing Letters*, 19(3-4):305–321, dec 2008.
- [3] Arthur Asuncion, Jac de Haan, Mehryar Mohri, Kayur Patel, Afshin Rostamizadeh, Umar Syed, and Lauren Wong. Corporate Learning at Scale: Lessons from a Large Online Course at Google. In *Proceedings of the first ACM conference on Learning @ scale conference - L@S '14*, pages 187–188, New York, New York, USA, 2014. ACM Press.
- [4] Jill Attewell. Mobile technologies and learning: A technology update and m-learning project summary. Technical report, Technology Enhanced Learning Research Centre, London, UK, 2005.
- [5] Marc Auge. Non-places: Introduction to an anthropology of supermodernity. *Capital & Class*, 20(3):144–145, jan 1996.
- [6] David E. Avison, Francis Lau, Michael D. Myers, and Peter Axel Nielsen. Action research. *Communications of the ACM*, 42(1):94–97, jan 1999.

-
- [7] Reinhold Behringer. Interoperability Standards for MicroLearning. In *MicroLearning Conference 7.0*, page 10. microlearning.org, 2013.
 - [8] Victoria Bellotti, Nicolas Ducheneaut, Mark Howard, and Ian Smith. Taking email to task: the design and evaluation of a task management centered email tool. In *Proceedings of the SIGCHI conference on Human factors in computing systems - CHI '03*, page 345, New York, New York, USA, 2003. ACM Press.
 - [9] Shlomo Ben-Hur. *The business of corporate learning: Insights from practice*. Cambridge University Press, Cambridge, UK, 1st edition, 2013.
 - [10] Zane L. Berge and Lin Y. Muilenburg, editors. *Handbook of Mobile Learning*. Routledge, New York, NY, USA, 2013.
 - [11] Frank Biocca, Chad Harms, and Judee K. Burgoon. Toward a More Robust Theory and Measure of Social Presence: Review and Suggested Criteria. *Presence: Teleoperators and Virtual Environments*, 12(5):456–480, oct 2003.
 - [12] Robert C. Blattberg, Byung-Do Kim, and Scott A. Neslin. *Database Marketing*, volume 18 of *International Series in Quantitative Marketing*. Springer New York, New York, NY, 2008.
 - [13] Sarah Boehle. iPod Corporation. *Training (ABI/ INFORM Global)*, 8(44):17–19, 2007.
 - [14] Nadire Cavus and Dogan Ibrahim. M-Learning: An experiment in using SMS to support learning new English language words. *British Journal of Educational Technology*, 40(1):78–91, 2009.
 - [15] Max Chafkin. Udacity’s Sebastian Thrun, Godfather Of Free Online Education, Changes Course. Available at: <http://www.fastcompany.com/3021473/udacity-sebastian-thrun-uphill-climb>, dec 2013. [Dostopano: 5. 6. 2016].

-
- [16] Chen, Hsieh, and Kinshuk. Effects of short-term memory and content representation type on mobile language learning. *Language Learning & Technology*, 12(3):93–113, 2008.
- [17] Thomas Cochrane. A summary and critique of m-learning research and practice. In Zane L. Berge and Lin Y. Muilenburg, editors, *Handbook of Mobile Learning*, chapter 3rd, pages 24–34. Routledge, New York, NY, USA, 2013.
- [18] Mary Louise Crescente and Doris Lee. Critical issues of m-learning: Design models, adoption processes, and future trends. *Journal of the Chinese Institute of Industrial Engineers*, 28(2):111–123, 2011.
- [19] Thomas H Davenport. Saving IT ’s Soul : Human-Centered Information Management. *Harvard Business Review*, 72(2, March-April):119–131, 1994.
- [20] D. R. Davis and J. T. Abbitt. An Investigation of the Impact of an Intervention to Reduce Academic Procrastination Using Short Message Service (SMS) Technology. *Journal of Interactive Online Learning*, 12(3):78–102, 2013.
- [21] Bert De Coutere. To MOOC, or not to MOOC. *Training Journal*, 2014(1):18–22, 2014.
- [22] J. Dunlosky, K. A. Rawson, E. J. Marsh, M. J. Nathan, and D. T. Willingham. Improving Students’ Learning With Effective Learning Techniques: Promising Directions From Cognitive and Educational Psychology. *Psychological Science in the Public Interest*, 14(1):4–58, jan 2013.
- [23] John Dunlosky, Katherine Rawson, Elizabeth J Marsh, Mitchell J Nathan, and Daniel T Willingham. What Works, What Doesn’t. *Scientific American Mind*, 24(4):46–53, aug 2013.

- [24] Chip Espinoza and Mick Ukleja. *Managing the Millennials: Discover the core competencies for managing today's workforce*. John Wiley & Sons, NJ, 2nd edition, 2016.
- [25] B J Fogg. Persuasive technology: Using computers to change what we think and do. *Ubiquity*, 2002(December):2, dec 2002.
- [26] B J Fogg. *Persuasive Technology*. Morgan Kaufmann, San Francisco, CA, USA, 1st edition, 2003.
- [27] B J Fogg. A behavior model for persuasive design. In *Proceedings of the 4th International Conference on Persuasive Technology - Persuasive '09*, page 1, New York, New York, USA, 2009. ACM Press.
- [28] Christopher Frayling. Research in Art and Design. *Royal College of Art Research Papers*, 1(1):1–5, 1993.
- [29] Marco R. Furtner, Urs Baldegger, and John F. Rauthmann. Leading yourself and leading others: Linking self-leadership to transformational, transactional, and laissez-faire leadership. *European Journal of Work and Organizational Psychology*, 22(4):436–449, aug 2013.
- [30] Cari Gillen-O'Neel, Virginia W. Huynh, and Andrew J. Fuligni. To Study or to Sleep? The Academic Costs of Extra Studying at the Expense of Sleep. *Child Development*, 84(1):133–142, 2013.
- [31] Tiong Thye Goh, Boon Chong Seet, and Nian Shing Chen. The impact of persuasive SMS on students' self-regulated learning. *British Journal of Educational Technology*, 43(4):624–640, 2012.
- [32] Colin Gray. *Designing online education for work based learners: Refining bite sized learning*. Doctoral, Abertay University, 2015.
- [33] Colin Gray. Developing Effective Online Staff Development through Short, Regular, Bite-Sized Tasks. *Journal of Perspectives in Applied Academic Practic*, 3(1):90–97, 2015.

-
- [34] Juho Hamari, Jonna Koivisto, and Tuomas Pakkanen. Do Persuasive Technologies Persuade? A Review of Empirical Studies. *Persuasive Technology*, 8462:118–136, 2014.
 - [35] Richard J. Harrington and Anthony K. Tjan. Transforming strategy one customer at a time. *Harvard Business Review*, 86(3), 2008.
 - [36] Helen Crompton. A historical overview of mobile learning: Toward learner-centered education. In Zane L. Berge and Lin Y. Muilenburg, editors, *Handbook of Mobile Learning*, chapter 1st, pages 3–14. Routledge, New York, NY, USA, 1st edition, 2013.
 - [37] Richard D Johnson, Steven Hornik, and Eduardo Salas. An empirical examination of factors contributing to the creation of successful e-learning environments. *International Journal of Human-Computer Studies*, 66(5):356–369, may 2008.
 - [38] Karl M. Kapp. *The Gamification of Learning and Instruction: Game-Based Methods and Strategies For Training And Education*. John Wiley & Sons, Hoboken, NJ, 2012.
 - [39] Perri Estes Kennedy, Seung Youn Chyung, Donald J. Winiecki, and Robert O. Brinkerhoff. Training professionals’ usage and understanding of Kirkpatrick’s Level 3 and Level 4 evaluations. *International Journal of Training and Development*, 18(1):1–21, mar 2014.
 - [40] Richard F Kenny, Jocelyne M C Van Neste-Kenny, Caroline L Park, Pamela a Burton, and Jan Meiers. Mobile learning in nursing practice education: Applying Koole’s FRAME model. *Journal of Distance Education*, 23(3):75–96, 2009.
 - [41] Alison Kidd. The marks are on the knowledge worker. In Beth Adelson, Susan Dumais, and Judith Olson, editors, *Proceedings of the SIGCHI conference on Human factors in computing systems*, pages 186–191, New York, New York, USA, 1994. ACM Press.

- [42] Chanmin Kim and John M. Keller. Effects of motivational and volitional email messages (MVEM) with personal messages on undergraduate students' motivation, study habits and achievement. *British Journal of Educational Technology*, 39(1):36–51, 2008.
- [43] Donald L. Kirkpatrick and James D. Kirkpatrick. Evaluating Training Programs. In *Evaluating Training Programs*, page 379. Berrett-Koehler Publishers, San Francisco, CA, USA, 3rd edition, 2006.
- [44] Ned Kock and Pedro Antunes. Government Funding of E-Collaboration Research in the European Union: A Comparison with the United States Model. *International Journal of E-Collaboration*, 3(2):36–41, 43–47, 2007.
- [45] Maria Konnikova. Why MOOCs are Failing the People They're Supposed to Help. Available at: <http://www.newyorker.com/science/maria-konnikova/moocs-failure-solutions>, 2014. [Dostopano: 5. 6. 2016].
- [46] Phillippa Lally, Cornelia H. M. van Jaarsveld, Henry W. W. Potts, and Jane Wardle. How are habits formed: Modelling habit formation in the real world. *European Journal of Social Psychology*, 40(6):998–1009, oct 2010.
- [47] Jean Lave and Etienne Wenger. Situated learning: Legitimate peripheral participation. *Learning in doing*, 95:138, 1991.
- [48] I-Fan Liu, Meng Chang Chen, Yeali S. Sun, David Wible, and Chin-Hwa Kuo. Extending the TAM model to explore the factors that affect Intention to Use an Online Learning Community. *Computers & Education*, 54(2):600–610, feb 2010.
- [49] Maxwell Maltz. *Psycho-Cybernetics, A New Way to Get More Living Out of Life*. Simon & Schuster, New York City, NY, 1st edition, 1960.

-
- [50] Claire McInerney. Knowledge management and the dynamic nature of knowledge. *Journal of the American Society for Information Science and Technology*, 53(12):1009–1018, oct 2002.
- [51] Andrew Miller. 4 Lessons We Can Learn from the "Failure" of MOOCs. <http://www.edutopia.org/blog/4-lessons-from-failure-of-moocs-andrew-miller>, 2014. [Dostopano: 5. 6. 2016].
- [52] Ned Kock. Action Research. In Mads Soegaard and Rikke Friis Dam, editors, *The Encyclopedia of Human-Computer Interaction*, 2nd Ed., chapter 33. The Interaction Design Foundation, Aarhus, Denmark, 2nd edition, 2013.
- [53] Harri Oinas-Kukkonen. A foundation for the study of behavior change support systems. *Personal and Ubiquitous Computing*, 17(6):1223–1235, aug 2013.
- [54] Harri Oinas-Kukkonen and Marja Harjumaa. A systematic framework for designing and evaluating persuasive systems. In *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, volume 5033 LNCS, pages 164–176, 2008.
- [55] Karen O’Leonard. The Corporate Learning Factbook 2014: Benchmarks, Trends, and Analysis of the U.S. Training Market. Technical report, Bersin by Deloitte, Oakland, CA, 2014.
- [56] Hsinyi Peng, Yi-Ju Su, Chien Chou, and Chin-Chung Tsai. Ubiquitous knowledge construction: Mobile learning re-defined and a conceptual framework. *Innovations in Education and Teaching International*, 46(2):171–183, 2009.
- [57] Paul R. Pintrich and Akane Zusho. Student Motivation and Self-Regulated Learning in the College Classroom. In Raymond P. Perry and John C. Smart, editors, *The Scholarship of Teaching and Learning*

- in Higher Education: An Evidence-Based Perspective*, chapter 16, pages 731–810. Springer Netherlands, Dordrecht, 2007.
- [58] C Reilly. MOOCs Deconstructed: Variables that Affect MOOC Success Rates. In Theo Bastiaens and Gary Marks, editors, *World Conference on E-Learning in Corporate, . . .*, pages 1308–1338. Association for the Advancement of Computing in Education (AACE), 2013.
- [59] Kelli Rosenthal. "Touch" vs. "tech": Valuing nursing-specific PDA software. *Nursing management*, 34(7):58–60, 2003.
- [60] Eduardo Salas, Mary P. Kosarzycki, C. Shawn Burke, Stephen M. Fiore, and Dianna L. Stone. Emerging themes in distance learning research and practice: Some food for thought. *International Journal of Management Reviews*, 4(2):135–153, jun 2002.
- [61] Donald Schön. *Beyond the stable state*. W. W. Norton & Company, New York City, NY, 1st edition, 1973.
- [62] Peter M Senge. *The Fifth Discipline: The Art and Practice of the Learning Organization*. Doubleday, New York, NY, USA, 1st edition, 1990.
- [63] Peter M. Senge. The fifth discipline. *Measuring Business Excellence*, 1(3):46–51, 1997.
- [64] B. F. Skinner. *Science and human behavior*. Free Press, New York City, NY, 1965.
- [65] Andy Stone. Mobile scaffolding: An experiment in using SMS text messaging to support first year university students. In *IEEE International Conference on Advanced Learning Technologies, 2004. Proceedings.*, pages 405–409. IEEE, 2004.
- [66] Gerald I. Susman and Roger D. Evered. An Assessment of the Scientific Merits of Action Research. *Administrative Science Quarterly*, 23(4):582, dec 1978.

-
- [67] John Traxler. Introduction. In John Traxler and Jocelyn Wishart, editors, *Making mobile learning work: case studies of practice*, chapter 1, pages 4–12. ESCalate Education Subject Centre: advanced learning and teaching in education, Bristol, UK, 2011.
- [68] Joshua R. Tyler and John C. Tang. When Can I Expect an Email Response? A Study of Rhythms in Email Usage. In Kari Kuutt and Eija Helena Karsten, editors, *ECSCW 2003*, pages 239–258, Dordrecht, 2003. Springer Netherlands.
- [69] Steve Whittaker and Candace Sidner. Email overload: Exploring personal information management of email. In *Proceedings of the SIGCHI conference on Human factors in computing systems*, pages 276–283, New York, New York, USA, 1996. ACM Press.
- [70] Gina Wisker. *Postgraduate Research Handbook: Succeed with your MA, MPhil, EdD and PhD*. Palgrave Macmillan, Basingstoke, United Kingdom, 2nd edition, 2007.
- [71] Andrew Withell, Thomas Cochrane, Stephen Reay, Idyl Gaziulusoy, and Shane Inder. Augmenting the Design Thinking Studio. In *Ascilite 2012 Future challenges sustainable futures*, page in pre print, 2012.
- [72] Robert H. Woods. How much communication is enough in online courses? Exploring the relationship between frequency of instructor-initiated personal email and learners’ perceptions of and participation in online learning. *International Journal of Instructional Media*, 29(4):377–394, 2002.
- [73] Wen Hsiung Wu, Yen Chun Jim Wu, Chun Yu Chen, Hao Yun Kao, Che Hung Lin, and Sih Han Huang. Review of trends from mobile learning studies: A meta-analysis. *Computers and Education*, 59(2):817–827, 2012.

-
- [74] Barry J. Zimmerman and Dale H. Schunk. Reflections on theories of self-regulated learning and academic achievement. In Barry J. Zimmerman and Dale H. Schunk, editors, *Self-regulated learning and academic achievement: Theoretical perspectives*, chapter 1st, pages 1–36. Taylor & Francis, 2nd edition, 2001.
- [75] John Zimmerman, Jodi Forlizzi, Shelley Evenson, John Zimmerman, Jodi Forlizzi, and Shelley Evenson. Research Through Design as a Method for Interaction Design Research in HCI. *Proceedings of the SIGCHI conference on Human factors in computing systems*, pages 493–502, 2007.